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ABSTRACT

Estimates of the number of persons willing to commute, at alternative wage rates, to job opportunities in north-central New Mexico have been based on results of basic research in the region and 1970 census data. Expressed willingness to commute and socio-economic characteristics data were accumulated from a regional survey of 643 households. The estimates are of value to regional planners and potential investors in north-central New Mexico, as they reflect the potential flow of labor resources within the region in response to new or expanded economic opportunity. Estimates of labor availability at various wage rates have been provided for the six primary population areas of this region. Tables specify wage rates from $1.60 an hour to $4.00 an hour and commuting time in intervals from under 15 minutes to over 90 minutes. Occupations include: professional and technical, managers and administrators, sales workers, transport operatives, laborers, farmers, service workers, clerical, and craftsmen. The availability of labor through commuting does not preclude individual needs for training or retraining to suit job needs. A computer program also is described which can be utilized to assess response to alternative wage rates. (Author/EA)

Expansion of Economic Base Analysis: Labor Availability in North-Central New Mexico

NEW MEXICO STATE UNIVERSITY

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EXPANSION OF ECONOMIC BASE ANALYSIS:

LABOR AVAILABILITY IN NORTH-CENTRAL NEW MEXICO

for

THE NORTH-CENTRAL NEW MEXICO ECONOMIC DEVELOPMENT DISTRICT

(State Planning and Development District II)

prepared by

the Agricultural Experiment Station

Department of Agricultural Economics and Agricultural Business

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Experiment Station Special Project

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August 1973 Las Cruces, New Mexico

SUMMARY

This report provides estimates of the number of persons willing to commute, at alternative wage rates, to job opportunities in north-central New Mexico. The estimates were based on results of basic research in the region and 1970 census data. These estimates are of value to regional planners and potential investors in north-central New Mexico, as they reflect the potential flow of labor resources within the region in response to new or expanded economic opportunity. Availability of labor through commuting does not preclude need for training or retraining of some individuals to suit the needs of industry, business, or government. In addition to estimates of labor availability, a computer program is described which can be utilized to assess response to alternative wage rates.

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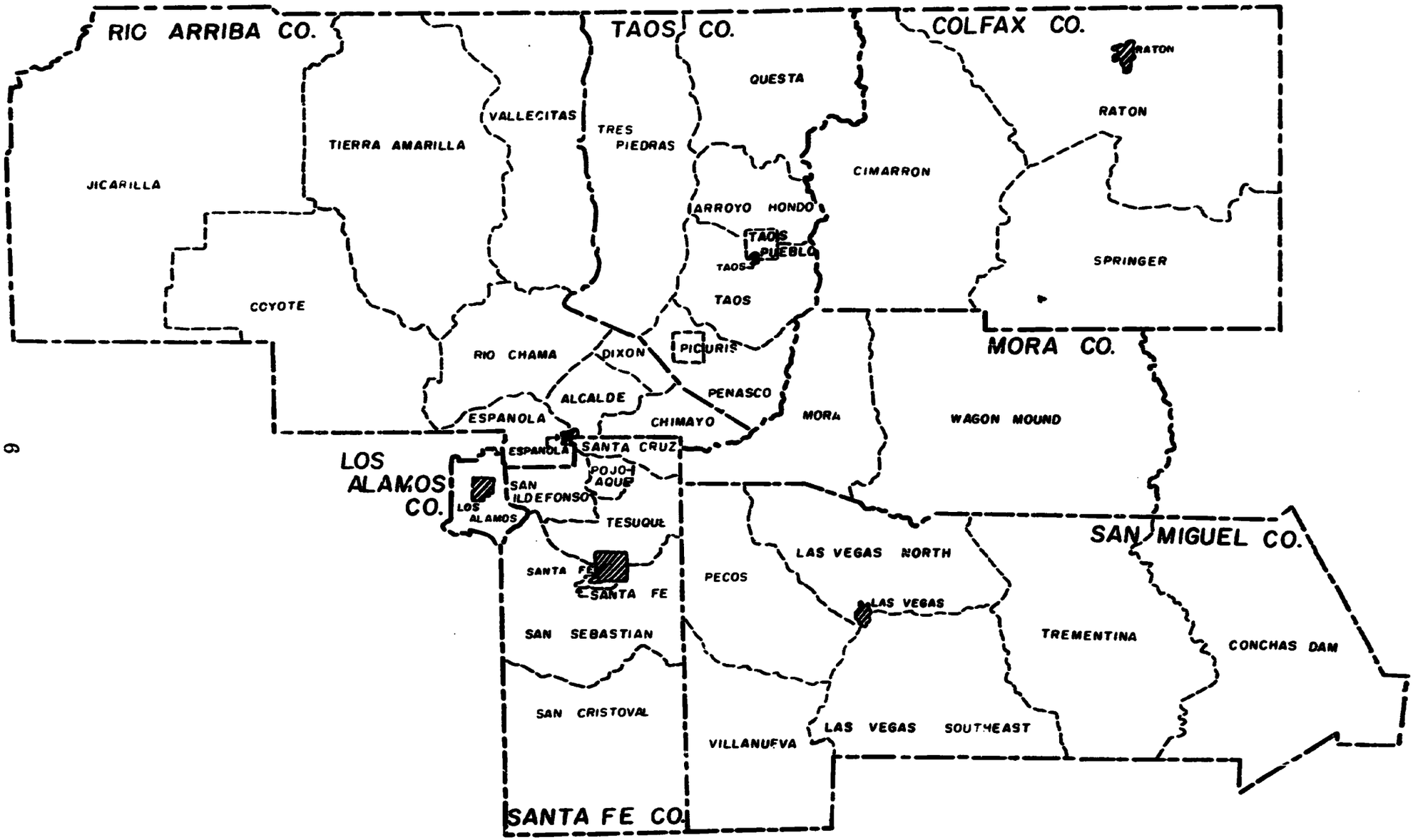


Map 1. North-central New Mexico by census county divisions and urban places.

INTRODUCTION

In a preliminary economic base analysis of north-central New Mexico (NCNM), Carruthers identified investment opportunities which appeared promising in terms of employment opportunities and increase in economic activity within the region.[1] For example, the development of a 100-ton-per-day particleboard plant in the region would result in a $3.5 million increase in regional output and create 180 to 200 new job opportunities principally for skilled and unskilled workers (figure 1). A projected $26 million increase in recreational expenditures by 1975 would raise the level of economic activity $40 million with significant new employment opportunities for unskilled workers (figure 2). Job opportunities for skilled workers would be particularly enhanced with the development of an apparel industry in the region (figure 3). Potential investors in these or other development opportunities will need to assess the availability of local labor for their enterprises prior to committing resources to a particular site. The general objective of this report-- an expansion of this economic base analysis-- is to provide these estimates of labor availability at various wage rates to the six primary population areas in NCNM: Taos, Espanola, Santa Fe, Los Alamos, Raton, and Las Vegas. These communities are the growth centers or potential growth centers for the region. Specifically, the objectives of the work are:

1. To develop a computer program which will project the labor pool available in NCNM and evaluate its dependence on salaries offered.

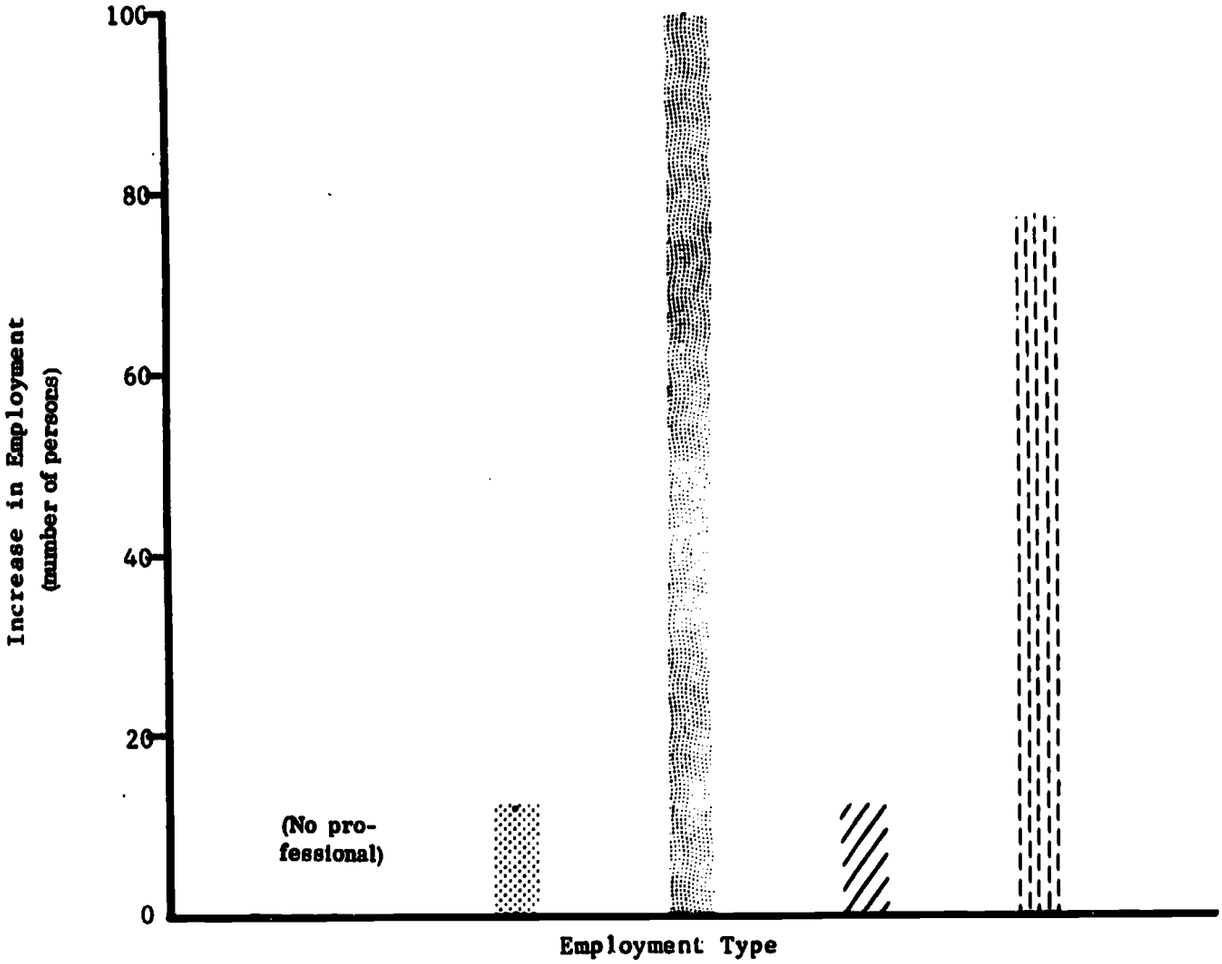
2. To utilize the computer program to estimate labor availability at selected sites in NCNM.

3. To provide approximations of labor pool boundaries for the six major cities in the region: Santa Fe, Taos, Espanola, Los Alamos, Raton, and Las Vegas.

The remainder of this report is in two major sections; the first gives a brief discussion of procedures. The second major section reports results, including a discussion of the programming technique, projected labor availability from each census county division and urban place, and maps of the labor market areas for each of the principal population areas. To enhance readability, all technical material appears in the appendix.

[1]Carruthers, Garrey E., "Preliminary Economic Potential Analysis for Northcentral New Mexico," a report to the Northcentral New Mexico Economic Development District, May, 1972.

Figure 1. Change in Output and Increased Employment necessary to support a 100-ton-per-day particleboard plant.



= Professional = Skilled = Unskilled

= Owner-Management = Clerical-Sales

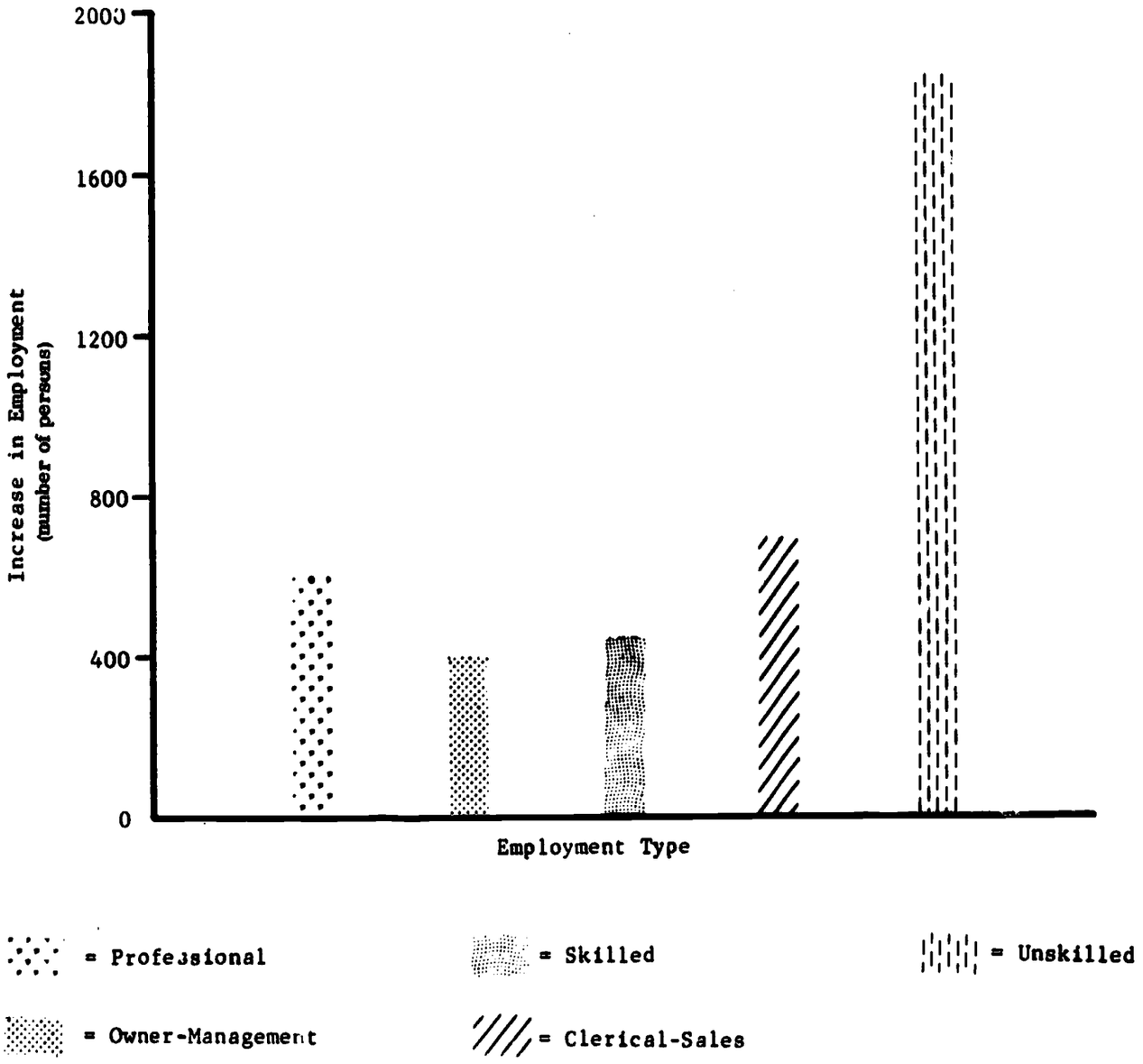
Change in Final Demand: $2,007,000

Change in Output: $3,500,246

Multiple: 1.74

Source: "Preliminary Economic Potential Analysis," table 15.

Figure 2. Change in Output and Increased Employment necessary to support increased Recreational Activity, 1975.



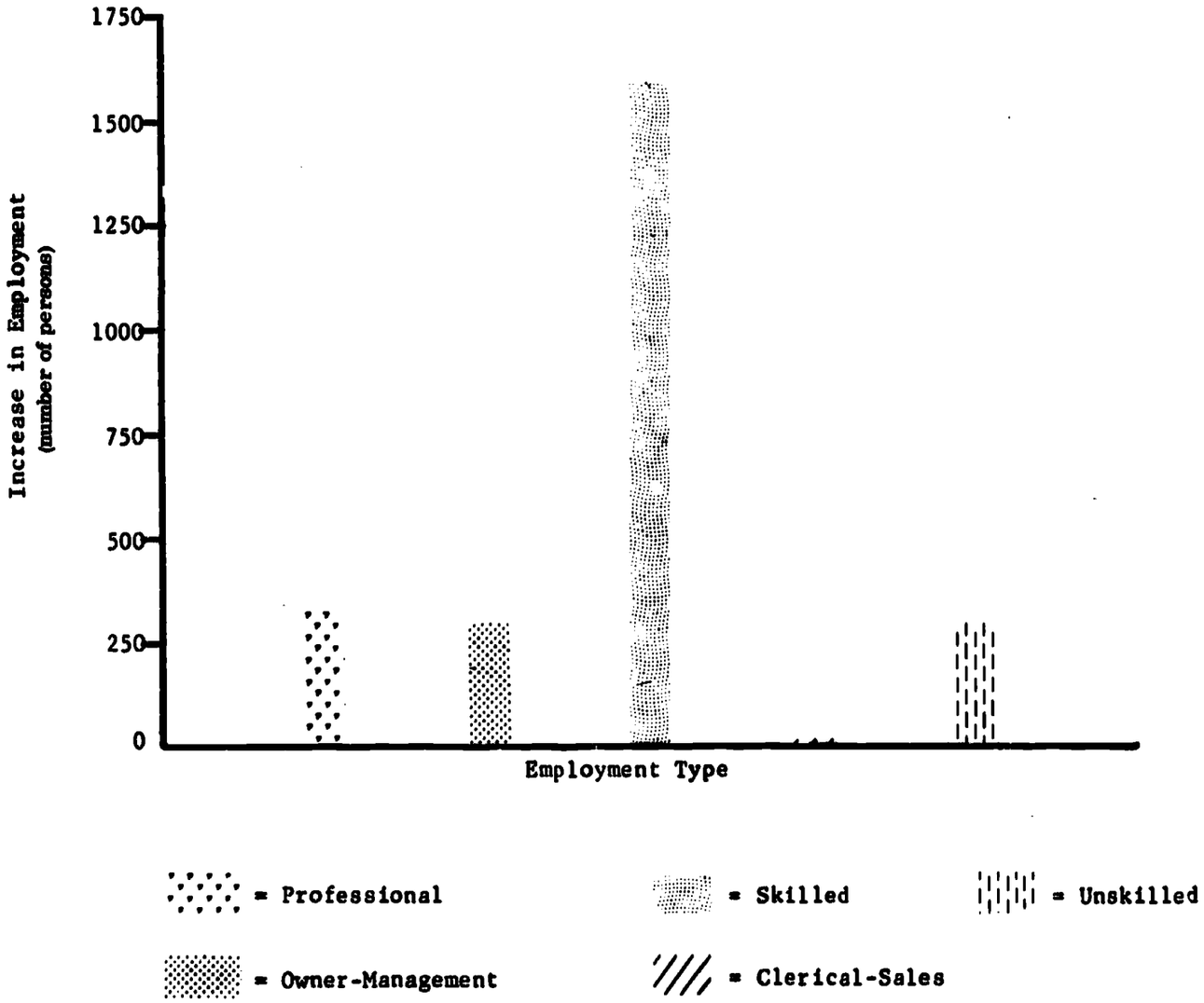
Change in Final Demand: $26,001,975

Change in Output: $40,297,216

Multiple: 1.55

Source: "Preliminary Economic Potential Analysis," table 10.

Figure 3. Change in Output and Increased Employment necessary to support increased export of apparel goods.



Source: "Preliminary Economic Potential Analysis," table 14.

Change in Final Demand: $40,000,000

Change in Output: $50,622,615

Multiple: 1.27

PROCEDURE SUMMARY

The procedure for projecting labor availability involves the application of basic research results to describe actual or potential outcomes. As noted in figure 4, the basic research input was a study by Carruthers, Urquhart, Eastman, and Gomez.[2] The general objective of the basic study was to test hypothesized relationships between the expressed willingness of NCNM residents to commute and the socio-economic characteristics of the households. The research team developed a technique for assessing willingness of individuals to commute at various levels of income incentives. This information and the socio-economic data utilized in this basic research was accumulated in a survey of 643 households in NCNM. There was sufficient confidence in results of the commuting mobility analysis to warrant an attempt to apply this information to a practical and important estimation problem. The socio-economic data from the basic study used in this analysis includes information of work expenses of respondents, their income, ethnicity, education, household size, occupation, vehicle ownership, home ownership, residence, and recent employment status.

As indicated in the procedure summary diagram, census county divisions and urban places were specified as labor sub-market areas. These designations from the 1970 Census of Population, illustrated in map 1, are the smallest possible geographic unit for which many of the above-mentioned socio-economic characteristics of the population are compiled.

A regression technique was used to estimate the relationship between expressed willingness to commute a specified time one way and the characteristics of the individuals. The dependent variable (willing to commute scores for north-central New Mexico residents) and the independent variables (experience working outside the county, years of education, size and composition of family, number in family working, occupation, number of weeks worked per year, income, home and auto ownership and ethnicity) are from the basic research by Carruthers, et al. Equations were developed for each of the following commuting times: less than 15 minutes, 15 to 30 minutes, 30 to 60 minutes, 60 to 90 minutes, and over 90 minutes one way. These equations permit estimation of the average willingness to commute a specified time by individuals having differing socio-economic characteristics. The socio-economic factors which were determined to be significant in developing the equations dictated the types of information to be accumulated on the labor sub-market areas. This is reflected in summary diagram by the dotted line from the equation estimation procedure to the accumulation step.

[2]Carruthers, Garrey E., N. Scott Urquhart, Clyde Eastman, and Billy Gomez, "A Socio-economic Analysis of Labor Mobility: Northcentral New Mexico," manuscript to be published by New Mexico State University Agricultural Experiment Station as Research Report 258.

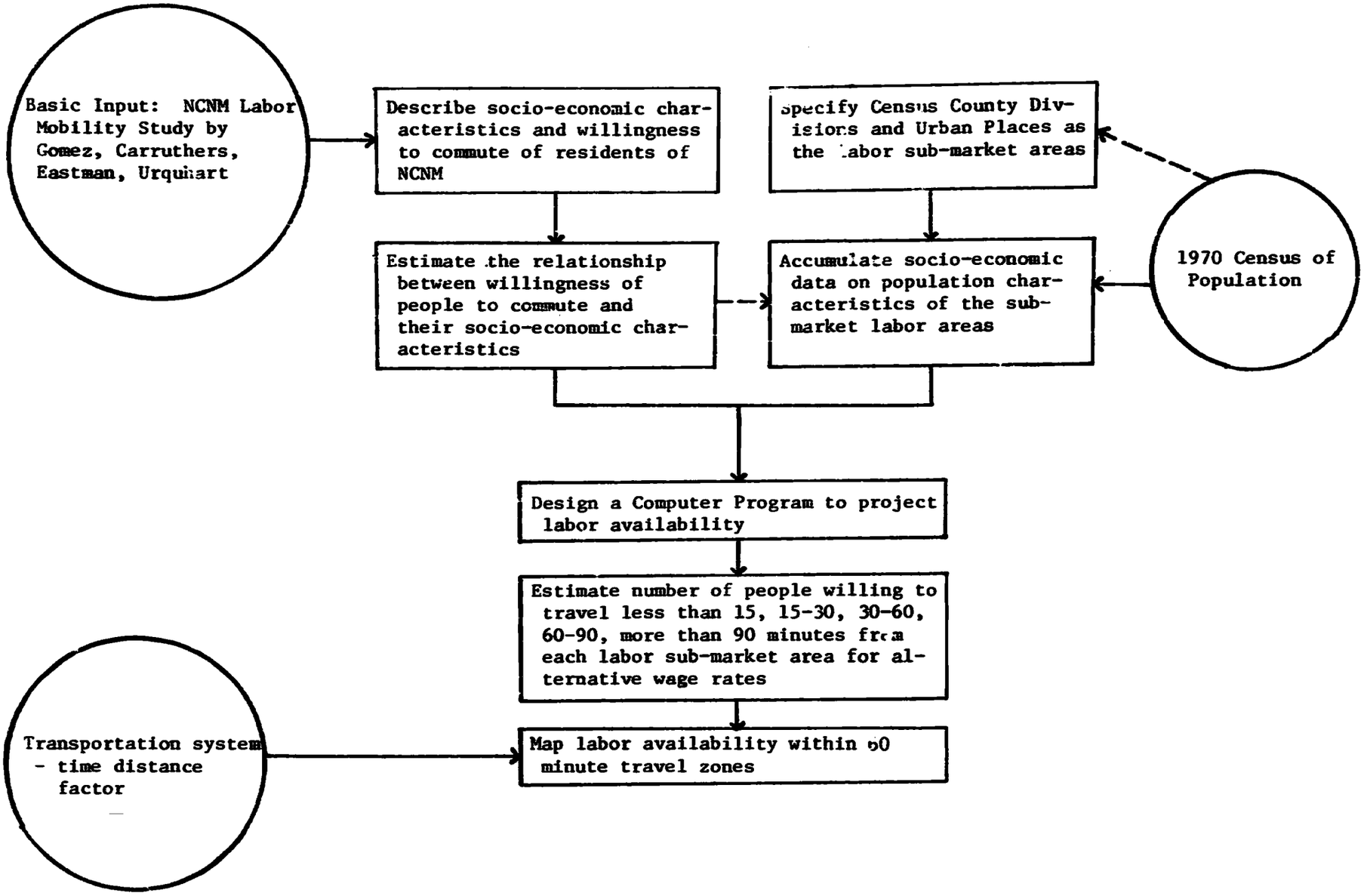


Figure 4. Procedure Summary Diagram, Expansion of Economic Base Analysis, 1973.

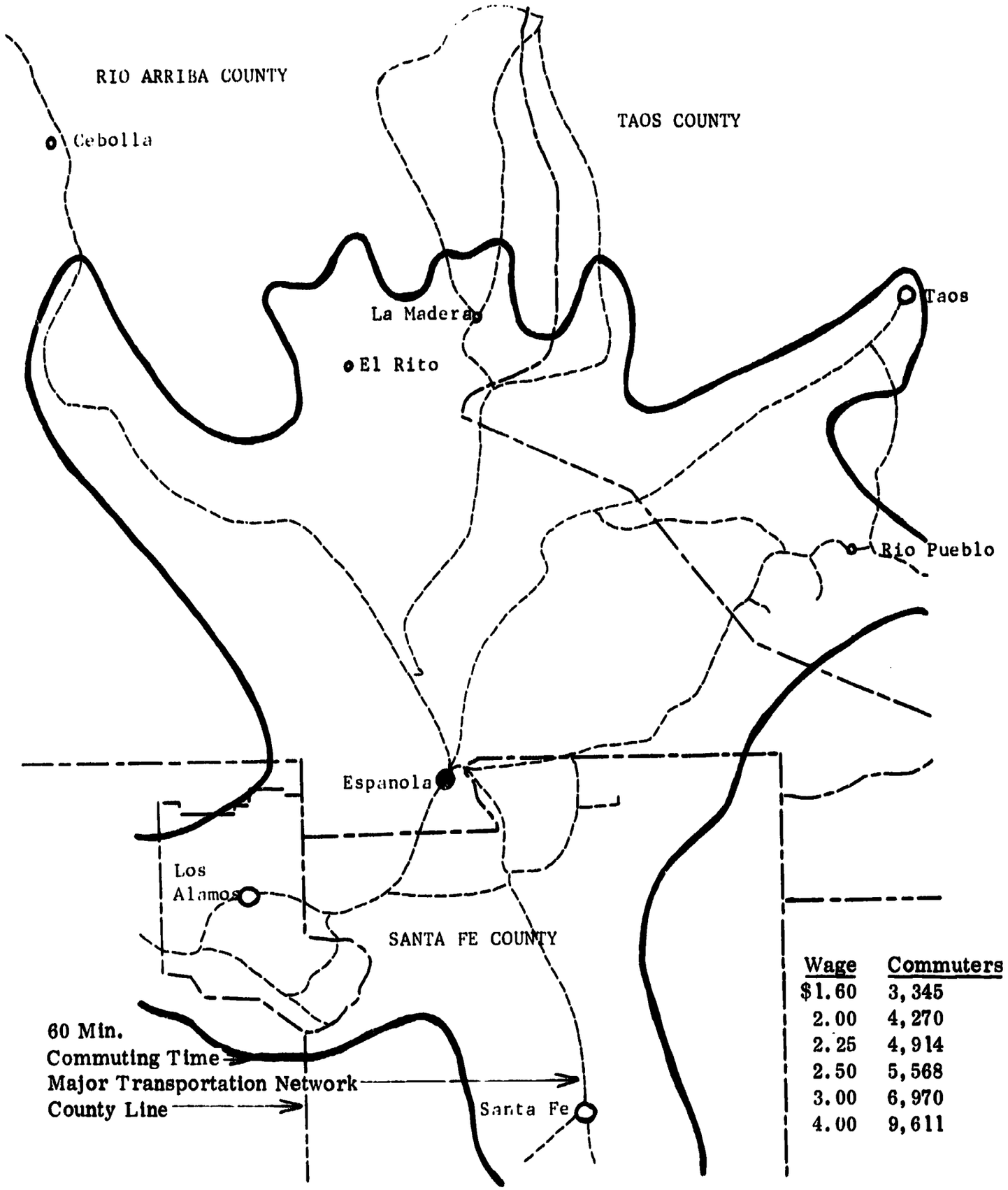
The equations noted and the data on population characteristics are two of the basic elements of the computer program. The program was written in APL (A Programming Language) for an IBM 360/50 computer. The development of this computer program was an objective of the study, hence, a more definitive treatment of the subject is included in the section on results and in the technical appendix.

The computer program yields estimates of the number of people willing to travel a specified time from each labor sub-market area for alternative wage rates. These estimates take into consideration that fully employed, relatively high wage earners are not motivated to commute at lower wage levels. Those projected to be part of the commuting population are near or below the annual income that would be forthcoming from each salary level. For example, at the minimum wage of $1.60 only individuals making less than $3,200 per year (assuming 2000 hours per year - fully employed) would be subject to an employment opportunity at this wage level. Thus, county census divisions and urban places with a relatively large number of high wage earners can be expected to furnish proportionately fewer of the mobile labor force.

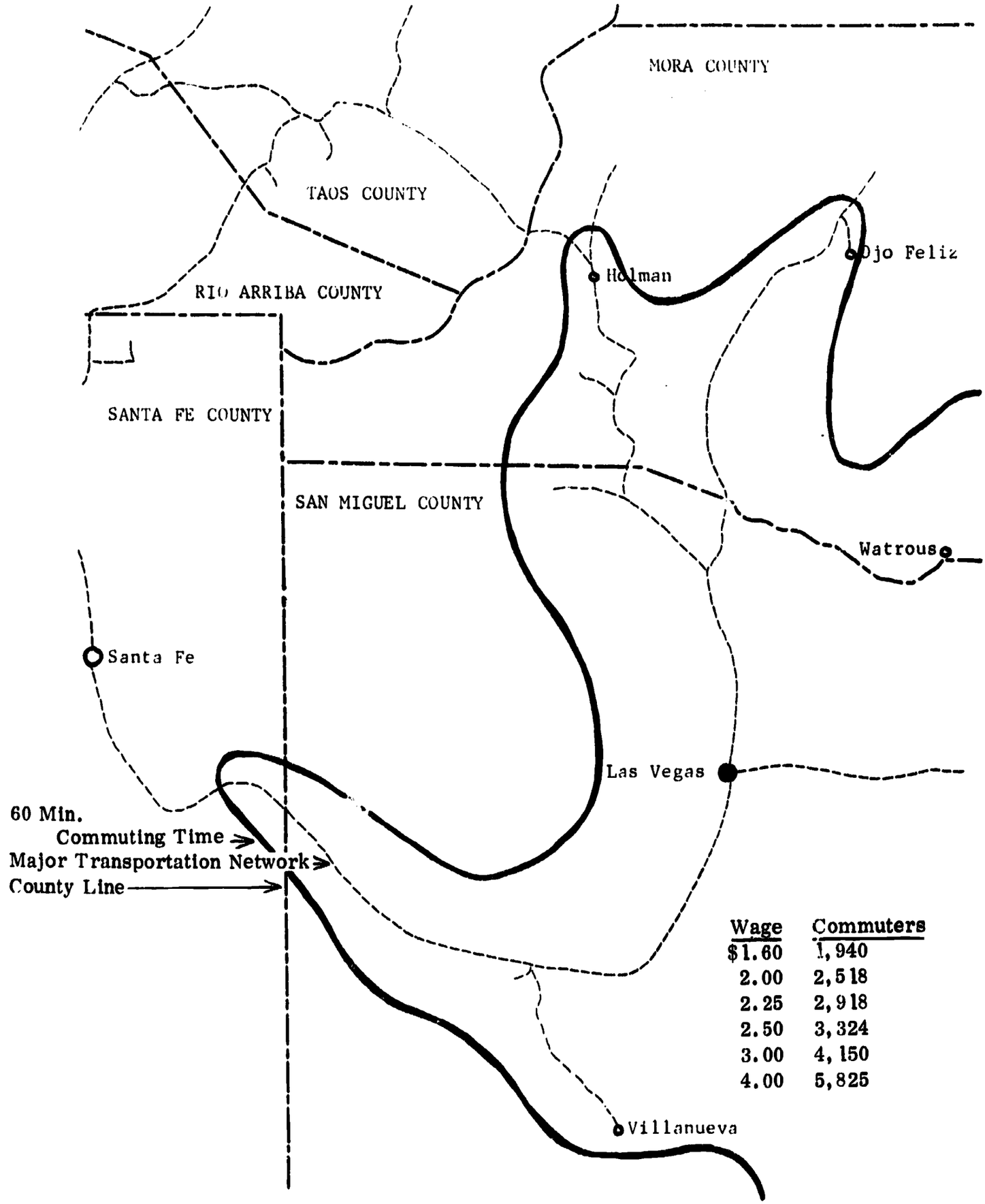
The last step in the study procedure was to develop labor availability maps for each of the principal urban places. This mapping scheme is based upon time - distance of 60 minutes one way from the central place. The contours are, of course, conditioned by the transportation system. Estimates of the number of persons available to a central urban place are taken from the county census division and urban place labor sub-market area tables developed in the preceding step of the study.

RESULTS

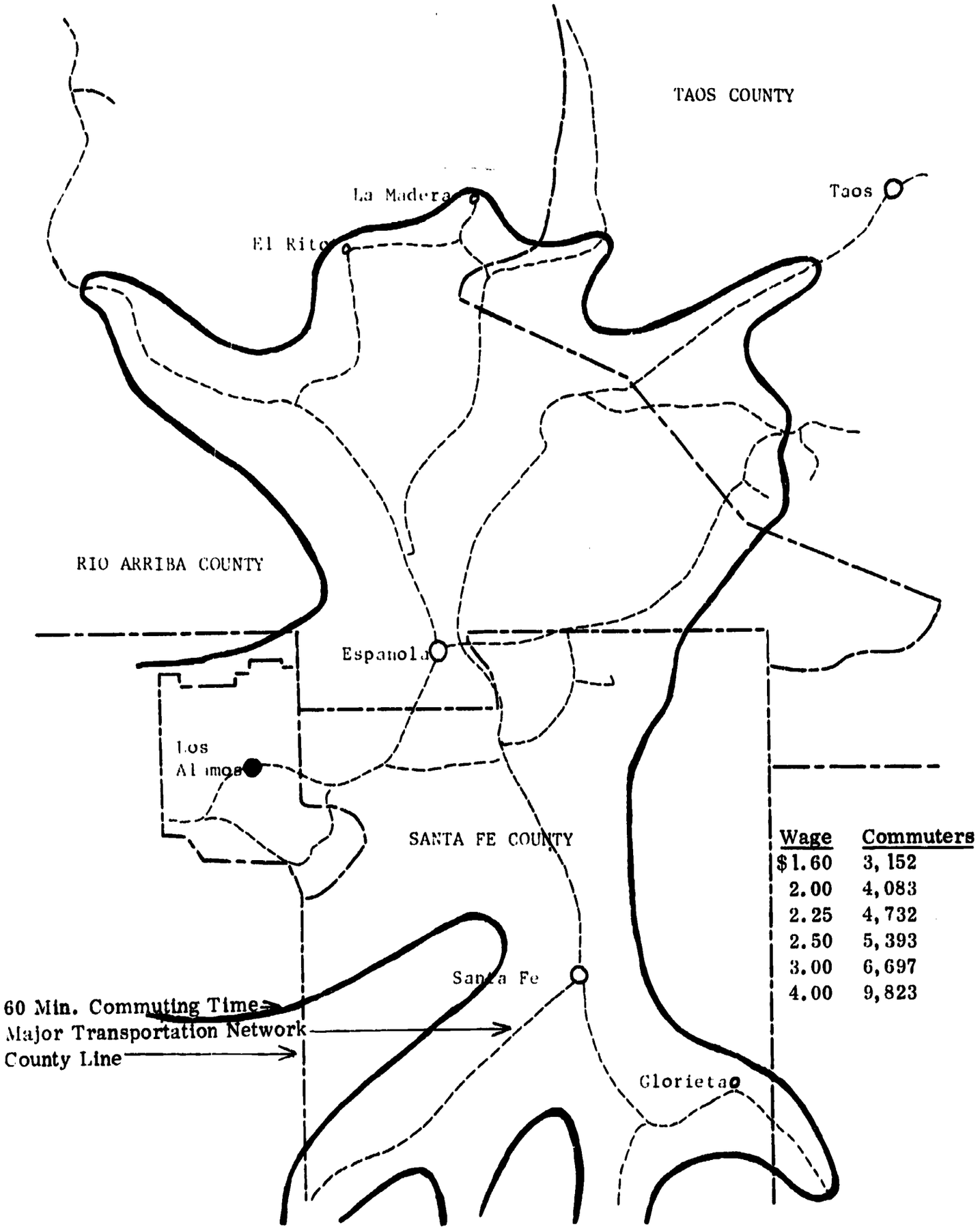
The review of the programming model is probably of interest to area planners and development research personnel. The remainder of this part of the report is relevant to these area strategists, but should be a particularly useful reference for individuals and/or companies comtemplating expansion or development of business firms in NCNM. Included as results are tables on the number of persons willing to commute a specified time from each census unit for different wage rates and labor area maps of the six principal cities.



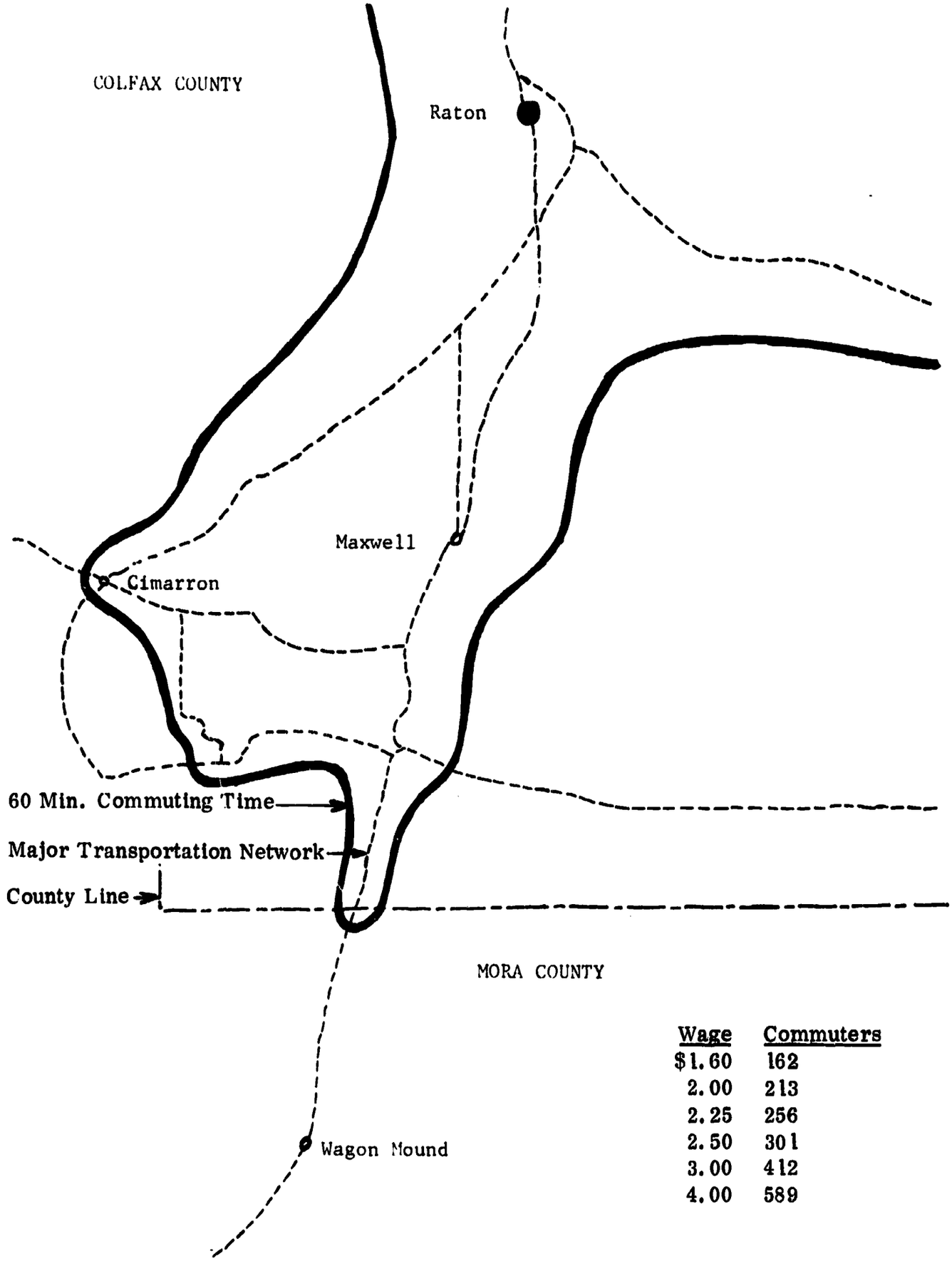
Map 2. Number of persons from within the major market area willing to commute to Espanola for specified wage rates.



Map 3. Number of persons from within the major market area willing to commute to Las Vegas for specified wage rates.

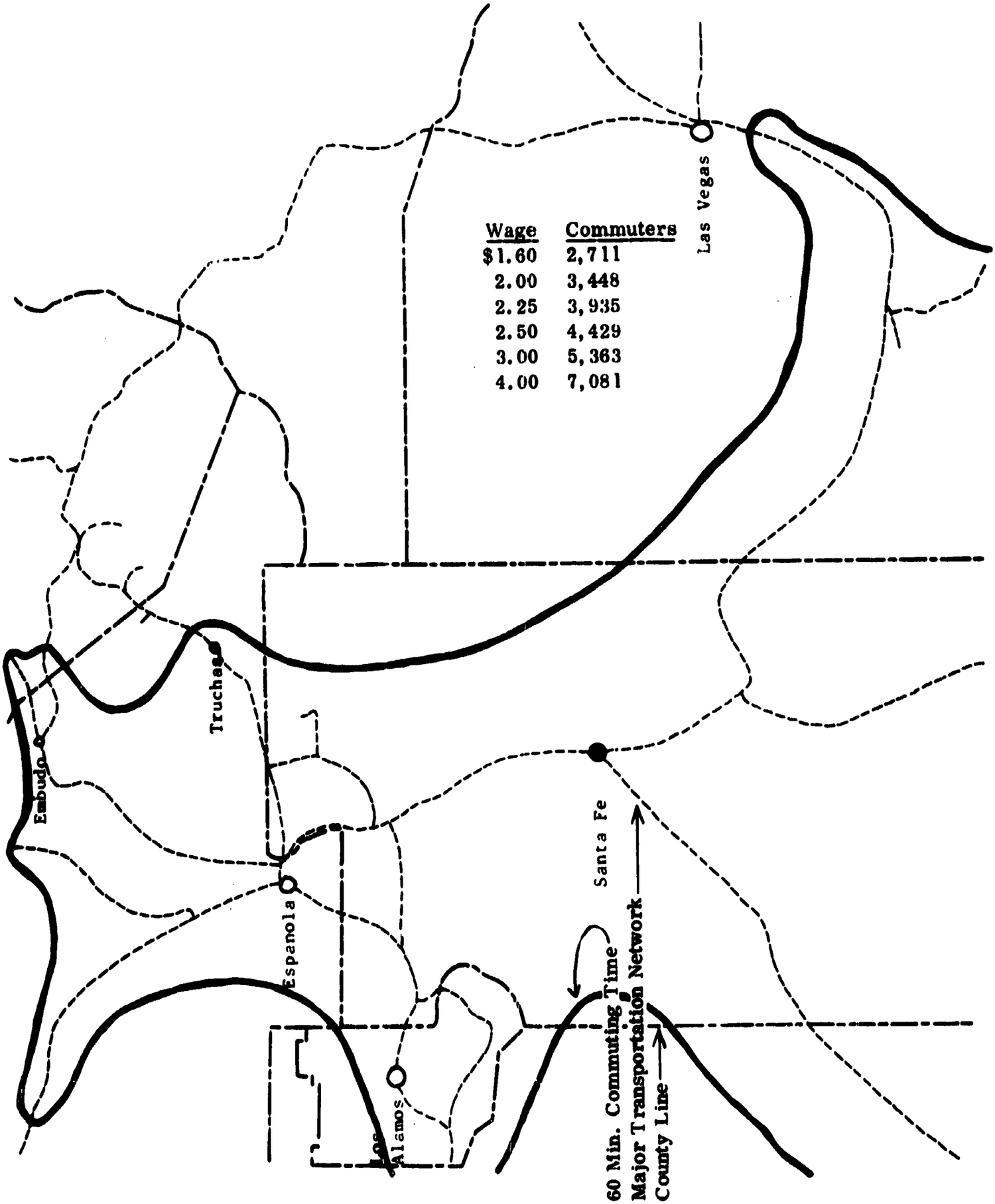


Map 4. Number of persons from within the major market area willing to commute to Los Alamos for specified wage rates.

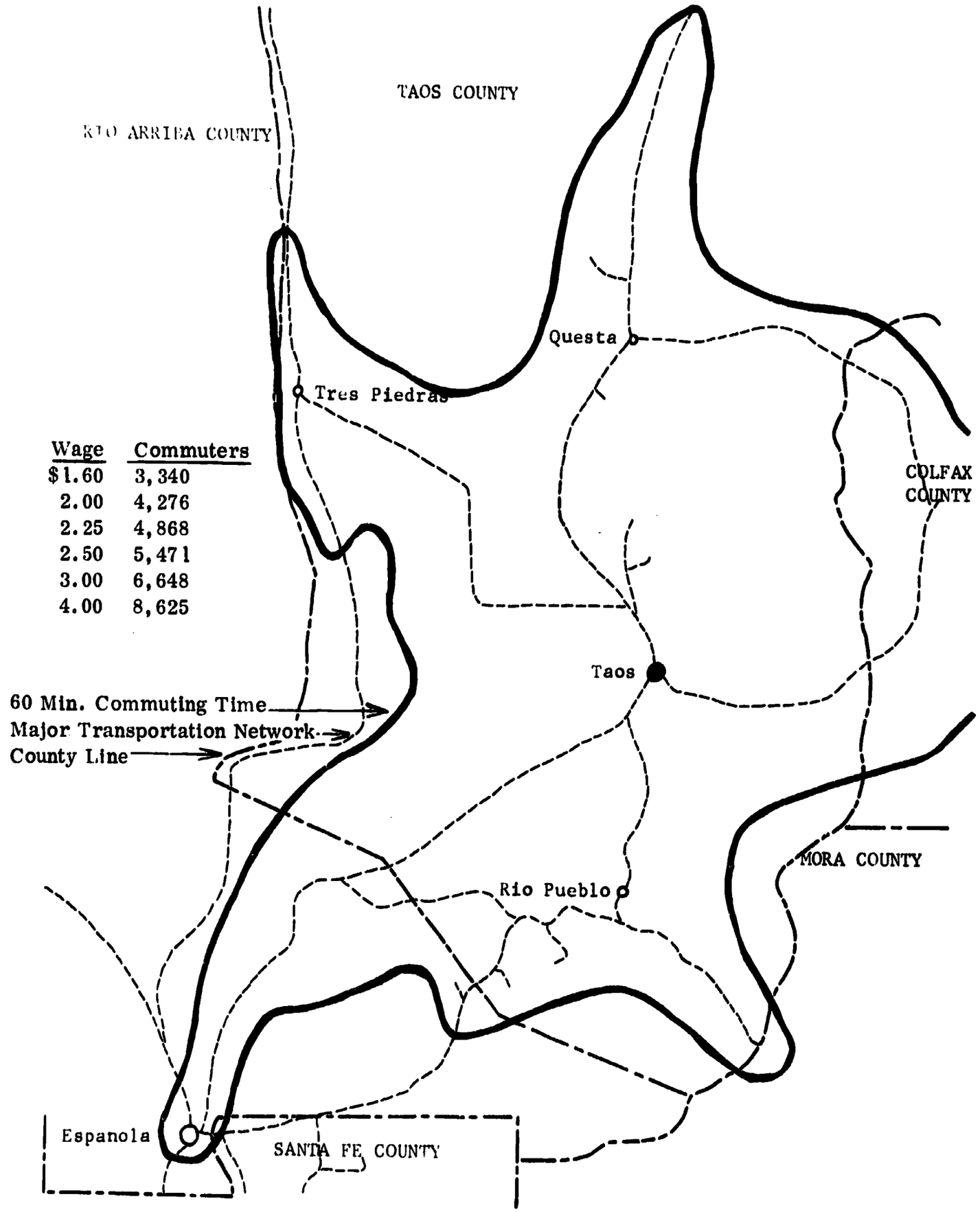


Wage	Commuters
$1.60	162
2.00	213
2.25	256
2.50	301
3.00	412
4.00	589

Map 5. Number of persons from within the major market area willing to commute to Raton for specified wage rates.



Map 6. Number of persons from within the major market area willing to commute to Santa Fe for specified wage rates.



Wage	Commuters
$1.60	3,340
2.00	4,276
2.25	4,868
2.50	5,471
3.00	6,648
4.00	8,625

Map 7. Number of persons from within the major market area willing to commute to Taos for specified wage rates.

Computer Program

The computer program developed and used in this study projects labor supply for various wage rates. Even though the preliminary and intermediate results involved fairly sophisticated uses of computers, this final program was designed for use by anyone, regardless of their experience with computers. The final program was written for use at a remote typewriter terminal; it takes less than a minute to activate a terminal, retrieve the program from the computer's storage and execute the necessary initialization. The programming sequence is started by typing the program name, COMMUTE, on the terminal typewriter. The computer responds with a request for the hourly wage rate (such as $1.60 - the minimum wage) of interest to the investigator. Once the wage rate has been stated and the typewriter paper properly aligned, the program solves for the number of persons willing to commute specified times from each census division for $1.60 an hour. Table 1 depicts the results of this program. Upon completion of the first table, the computer "inquires" if another table is desired. By typing YES, and a new wage rate, the programming solution is repeated and another table, such as table 2, is developed. This sequence may be repeated as many times as desired with the computer numbering the tables consecutively. The program and supporting details appear in the technical appendix.

If a person is exposed to a new employment opportunity, his financial evaluation of it will focus primarily on how it will change his income. Even though available income data record only current income levels, the data must be interpreted in terms of change in income. Furthermore, a potential commuter's evaluation of any change in income depends on his social, demographic, and economic characteristics. For example, home owners react differently from renters; farm laborers respond differently from operators of heavy construction machinery.

Thus the program has two separate parts. The first part uses the wage rate indicated by the investigator to transform the income distribution for each census unit into a distribution of raises; i. e., increases in annual income. For example, $1.60 per hour is equivalent to about $3,200 per year at full employment. This would represent an annual raise of $800 for a family unit now earning $2,400 per year. It was necessary to make this transformation because the original data evaluated willingness to commute relative to changes in family income, rather than annual income.

The second part of the final program distributes the number of households in each cell of the raise distribution across commuting times, and then sums this across raise levels to produce the number of people in each census unit willing to commute specified times. These calculations are based on mean willingness to commute for each reward level in each census unit, as shown in table 7. These mean calculations reflect the aggregate demographic and socio-economic characteristics of the census units and are based on predictive equations developed from data in the willingness to commute study.

Even though the final program appears short and simple, it utilizes both the power of the APL computer language and previously executed computations. These calculations primarily used stepwise multiple regression[3] executed with BMDO2R from the widely available BIOMED statistical package, and programs written to extract the specific information required from census magnetic tape summaries. Detailed procedures and relevant summaries of the information developed with both of these approaches appear in the technical appendix. The same procedures would apply to other geographic areas provided a comparable base study was available.

Number of Persons Willing to Commute

The numbers of persons willing to commute to job opportunities from each census unit for wage rates of $1.60, $2.00, $2.25, $2.50 and $3.00 per hour are listed in tables 1 through 5 respectively. Table 6, reflecting numbers willing to commute at $4.00 per hour, was included to represent an extreme but is not discussed in the text.

Interpreting the first row of table 1, there are an estimated 85 persons in the Cimmaron census county division willing to commute up to 15 minutes one way for employment at $1.60 per hour. Sixteen of these 85 would not, however, be willing to commute up to 30 minutes one way; i. e., only 69 of the original commuters in the Cimmaron district are willing to commute this far. At the extreme, over 90 minutes commuting time one way, only 9 of the original 85 remain as potential labor prospects. In other words, approximately 9 Cimmaron residents would find a wage rate of $1.60 per hour attractive enough to commute 90 minutes to the opportunity.

Number of persons willing to commute from predominately rural areas of each county by wage level is the sum of those willing to commute from each census county division. Note in table 1 that Raton, the county seat of Colfax county, is listed at the bottom of the table under Urban Places. To estimate the total number of persons willing to commute in Colfax county, the census county divisions (rural areas) total must be added to the total for Raton (urban place). (209 willing to commute from county census divisions plus 289 willing to commute from Raton equals 498 Colfax county commuters.) Los Alamos city and county are considered simultaneously in all the tables because the majority of the county's population resides in the city. The city of Taos missed classification as an urban area by 25 people at the last census, hence Taos is still listed as a census county division.

[3]Draper and H. Smith, 1966. Applied Regression Analysis. Wiley, N. Y. See chapter 6 for a detailed explanation of the stepwise procedure.

Under any wage conditions, it appears that Rio Arriba and Taos counties along with Las Vegas and Santa Fe are the major origins of commuting labor. Economic developers may find it advantageous to locate in one of these areas.

An increase in the wage rate from $1.60 to $3.00 per hour will result in varying levels of commuting response by areas. For example, Colfax, Santa Fe, and Los Alamos counties and the urban places, Raton, Espanola, and Santa Fe are projected to have over 100 percent increase in the number of commuters with the increase in income resulting from the additional $1.40 per hour. The increase for this group ranges from 110 to 144 percent. On the other hand, this substantial increase in wage offerings would only stimulate from 54 to 83 percent more commuters in Mora, Rio Arriba, San Miguel, and Taos counties, and the city of Las Vegas. A higher proportion of those willing to commute from these latter areas may be motivated to do so at lower wage levels because their incomes were relatively lower at the outset.

Table 7 summarizes the mean willingness to commute of residents of the various census units by alternative reward levels in dollars per month. A score of 1 reflects a mean willingness to commute 15 minutes one way, 2 indicates 30 minutes, 3 indicates 60 minutes, and 4 represents a willingness to commute 90 minutes one way. For example, the mean willingness to commute of Cimarron residents for a $0-$50 increase in monthly income is 1.42, indicating an average willingness to commute of somewhat more than 15 minutes for this increase in income. Increasing the reward level from 50 to 150 dollars would induce Cimarron residents to commute an average of 30 plus minutes one way. This table is a guide to those attempting to identify labor responses to incentives by selected areas in NCNM.

TABLE 1: NUMBER OF PERSONS WILLING TO COMMUTE SPECIFIED TIMES FOR $1.60 AN HOUR, BY CENSUS UNIT.

CENSUS UNIT	COMMUTING TIME, ONE WAY, IN MINUTES UP TO 15	UP TO 30	UP TO 60	UP TO 90	OVER 90
CENSUS COUNTY DIVISIONS					
COLFAX COUNTY					
CIMARRON	85	69	46	24	9
RATON	6	4	3	2	1
SPRINGER	118	95	62	31	12
	209	168	111	57	22
MORA COUNTY					
MORA	278	225	150	78	30
WAGON MOUND	207	179	132	77	33
	485	404	282	155	63
RIO ARRIBA COUNTY					
ALCALDE	254	224	170	104	48
CHIMAYO	240	213	164	101	47
COYOTE	119	101	73	42	18
DIXON	120	110	89	59	30
ESPANOLA	161	124	78	38	13
JICARILLA	93	82	62	38	17
RIO CHAMA	191	173	138	89	44
TIERRA AMARILLA	182	159	119	71	31
VALLECITAS	84	79	68	49	28
	1444	1265	961	591	276
SAN MIGUEL COUNTY					
CONCHAS DAM	10	8	5	3	1
LAS VEGAS NORTH	100	90	70	44	21
LAS VEGAS SOUTHEAST	54	33	16	6	2
PECOS	179	154	113	66	29
TREMENTINA	31	27	19	11	5
VILLANUEVA	195	160	109	58	23
	569	472	332	188	81
SANTA FE COUNTY					
POJOAQUE	40	35	25	15	6
SAN CRISTOVAL	18	14	9	4	2
SAN ILDEFONSO	68	61	48	31	15
SAN SEBASTIAN	108	93	67	38	16
SANTA CRUZ	80	67	48	26	11
SANTA FE	52	45	33	19	8
TESUQUE	52	46	36	22	10
	418	361	266	155	68
TAOS COUNTY					
ARROYO HONDO	112	97	71	41	18
PENASCO	95	79	55	30	12
PICURIS	136	112	76	40	16
QUESTA	129	112	83	49	21
TAOS	553	477	351	205	89
TAOS PUEBLO	162	145	114	72	35
TRES PIEDRAS	28	20	12	5	2
	1215	1042	762	442	193
URBAN PLACES					
RATON	289	249	182	106	46
LOS ALAMOS	77	61	39	19	7
ESPANOLA	184	159	116	68	29
LAS VEGAS	951	842	644	395	182
SANTA FE	1251	1088	807	474	208

TABLE 2: NUMBER OF PERSONS WILLING TO COMMUTE SPECIFIED TIMES FOR $2.00 AN HOUR, BY CENSUS UNIT.

CENSUS UNIT	COMMUTING TIME, ONE WAY, IN MINUTES UP TO 15	UP TO 30	UP TO 60	UP TO 90	OVER 90
CENSUS COUNTY DIVISIONS					
COLFAX COUNTY					
CIMARRON	102	85	59	32	13
RATON	9	7	5	2	1
SPRINGER	157	128	87	45	17
	268	220	151	79	31
MORA COUNTY					
MORA	339	285	202	114	49
WAGON MOUND	240	212	160	96	44
	579	497	362	210	93
RIO ARRIBA COUNTY					
ALCALDE	309	279	219	140	68
CHIMAYO	275	249	199	130	66
COYOTE	148	129	97	59	28
DIXON	136	126	105	72	38
ESPANOLA	216	173	115	59	23
JICARILLA	107	97	76	48	23
RIO CHAMA	221	203	167	113	59
TIERRA AMARILLA	226	201	156	97	45
VALLECITAS	103	98	85	63	38
	1741	1555	1219	781	388
SAN MIGUEL COUNTY					
CONCHAS DAM	14	11	7	4	2
LAS VEGAS NORTH	110	101	83	55	28
LAS VEGAS SOUTHEAST	68	46	24	10	3
PECOS	220	195	149	92	43
TRENTENTINA	39	34	25	15	7
VILLANUEVA	244	206	148	84	36
	695	593	436	260	119
SANTA FE COUNTY					
POJOAQUE	67	57	41	23	10
SAN CRISTOVAL	27	21	13	7	3
SAN ILDEFONSO	77	71	58	38	20
SAN SEBASTIAN	144	125	93	55	24
SANTA CRUZ	96	83	61	36	16
SANTA FE	70	62	47	29	13
TESUQUE	72	64	49	31	15
	553	483	362	219	101
TAOS COUNTY					
ARROYO HONDO	136	120	91	56	26
PENASCO	118	102	75	44	19
PICURIS	185	156	111	62	26
QUESTA	157	140	108	67	31
TAOS	697	613	465	282	129
TAOS PUEBLO	203	183	146	96	48
TRES PIEDRAS	39	29	18	9	4
	1535	1343	1014	616	283
URBAN PLACES					
RATON	395	347	261	157	71
LOS ALAMOS	89	72	48	24	9
ESPANOLA	234	205	154	93	42
LAS VEGAS	1217	1093	856	543	261
SANTA FE	1654	1455	1100	683	299

TABLE 3: NUMBER OF PERSONS WILLING TO COMMUTE SPECIFIED TIMES FOR $2.25 AN HOUR, BY CENSUS UNIT.

CENSUS UNIT	COMMUTING TIME, ONE WAY, IN MINUTES UP TO 15	UP TO 30	UP TO 60	UP TO 90	OVER 90
CENSUS COUNTY DIVISIONS					
COLFAX COUNTY					
CIMARRON	123	102	71	39	16
RATON	12	9	6	3	1
SPRINGER	184	152	104	55	22
	319	263	181	97	39
MORA COUNTY					
MORA	367	314	229	134	59
WAGON MOUND	260	231	177	108	50
	627	545	406	242	109
RIO ARRIBA COUNTY					
ALCALDE	354	320	254	165	82
CHIMAYO	312	281	224	147	75
COYOTE	168	148	113	70	33
DIXON	150	138	115	79	42
ESPANOLA	249	204	140	75	31
JICARILLA	129	115	90	57	28
RIO CHAMA	228	213	178	123	66
TIERRA AMARILLA	247	223	175	111	54
VALLECITAS	112	107	95	72	44
	1949	1749	1384	899	455
SAN MIGUEL COUNTY					
CONCHAS DAM	23	18	12	6	3
LAS VEGAS NORTH	126	116	95	63	33
LAS VEGAS SOUTHEAST	78	55	31	14	5
PECOS	241	216	170	108	53
TREMENTINA	47	40	30	18	8
VILLANUEVA	268	231	170	100	44
	783	676	508	309	146
SANTA FE COUNTY					
POJOAQUE	87	73	53	30	13
SAN CRISTOVAL	35	27	17	8	3
SAN ILDEFONSO	95	86	69	45	23
SAN SEBASTIAN	169	148	111	67	30
SANTA CRUZ	105	92	68	41	18
SANTA FE	85	77	59	37	17
TESUQUE	85	76	59	37	18
	662	579	436	265	122
TAOS COUNTY					
ARROYO HONDO	154	136	105	65	31
PENASCO	138	120	91	56	26
PICURIS	206	178	131	77	35
QUESTA	173	156	123	78	38
TAOS	766	682	527	327	153
TAOS PUEBLO	217	199	162	108	55
TRES PIEDRAS	46	35	22	11	4
	1700	1506	1161	722	342
URBAN PLACES					
RATON	471	416	318	194	90
LOS ALAMOS	109	87	57	29	11
ESPANOLA	265	234	178	108	50
LAS VEGAS	1353	1225	973	629	309
SANTA FE	1966	1733	1316	800	365

TABLE 4: NUMBER OF PERSONS WILLING TO COMMUTE SPECIFIED TIMES FOR $2.50 AN HOUR, BY CENSUS UNIT.

CENSUS UNIT	COMMUTING TIME, ONE WAY, IN MINUTES UP TO 15	UP TO 30	UP TO 60	UP TO 90	OVER 90
CENSUS COUNTY DIVISIONS					
COLFAX COUNTY					
CIMARRON	146	122	85	47	19
RATON	15	12	8	4	2
SPRINGER	213	176	122	65	26
	374	310	215	116	47
MORA COUNTY					
MORA	392	340	254	152	69
WAGON MOUND	280	249	192	119	55
	672	589	446	271	124
RIO ARRIBA COUNTY					
ALCALDE	400	363	291	191	96
CHIMAYO	351	317	253	166	85
COYOTE	188	167	129	81	39
DIXON	163	151	125	87	47
ESPANOLA	282	234	164	91	38
JICARILLA	151	135	106	68	33
RIO CHAMA	234	220	186	131	72
TIERRA AMARILLA	267	242	193	125	62
VALLECITAS	121	116	103	79	49
	2157	1945	1550	1019	521
SAN MIGUEL COUNTY					
CONCHAS DAM	33	27	18	9	4
LAS VEGAS NORTH	143	132	108	73	38
LAS VEGAS SOUTHEAST	86	63	37	17	6
PECOS	261	236	189	123	62
TREMENTINA	55	48	36	22	10
VILLANUEVA	292	254	190	115	53
	870	760	578	359	173
SANTA FE COUNTY					
POJOAQUE	107	91	66	38	17
SAN CRISTOVAL	43	33	20	10	4
SAN ILDEFONSO	115	104	83	54	27
SAN SEBASTIAN	195	172	130	79	36
SANTA CRUZ	115	100	75	45	21
SANTA FE	103	92	72	45	22
TESUQUE	99	89	70	44	21
	777	681	516	315	148
TAOS COUNTY					
ARROYO HONDO	172	153	119	75	37
PENASCO	158	140	107	68	33
PICURIS	226	199	150	92	43
QUESTA	189	172	137	88	44
TAOS	832	747	583	368	175
TAOS PUEBLO	231	213	175	118	62
TRES PIEDRAS	53	41	26	13	5
	1861	1665	1297	822	399
URBAN PLACES					
RATON	548	488	376	233	109
LOS ALAMOS	130	104	69	34	13
ESPANOLA	295	262	201	124	58
LAS VEGAS	1486	1353	1085	710	355
SANTA FE	2285	2023	1546	946	435

TABLE 5: NUMBER OF PERSONS WILLING TO COMMUTE SPECIFIED TIMES FOR $3.00 AN HOUR, BY CENSUS UNIT.

CENSUS UNIT	COMMUTING TIME, ONE WAY, IN MINUTES UP TO 15	UP TO 30	UP TO 60	UP TO 90	OVER 90
CENSUS COUNTY DIVISIONS					
COLFAX COUNTY					
CIMARRON	194	163	115	64	27
RATON	30	23	15	7	3
SPRINGER	282	235	163	89	36
	506	421	293	160	66
MORA COUNTY					
MORA	431	383	295	183	86
WAGON MOUND	316	283	221	138	65
	747	666	516	321	151
RIO ARRIBA COUNTY					
ALCALDE	448	414	339	229	118
CHIMAYO	399	365	295	197	102
COYOTE	205	187	151	101	52
DIXON	188	175	146	101	54
ESPANOLA	357	302	219	127	56
JICARILLA	181	164	131	85	43
RIO CHAMA	267	250	212	151	83
TIERRA AMARILLA	305	279	225	148	75
VALLECITAS	138	133	113	93	58
	2488	2269	1837	1232	641
SAN MIGUEL COUNTY					
CONCHAS DAM	40	34	24	13	6
LAS VEGAS NORTH	176	162	133	90	47
LAS VEGAS SOUTHEAST	105	82	52	26	10
PECOS	291	268	219	148	77
TREMENTINA	57	51	40	26	13
VILLANUEVA	319	284	220	137	65
	988	881	688	440	218
SANTA FE COUNTY					
POJOAQUE	142	124	92	55	24
SAN CRISTOVAL	50	40	26	13	5
SAN ILDEFONSO	139	128	103	68	34
SAN SEBASTIAN	238	212	163	101	48
SANTA CRUZ	156	134	100	59	27
SANTA FE	158	140	109	68	32
TESUQUE	123	111	89	57	28
	1006	889	682	421	198
TAOS COUNTY					
ARROYO HONDO	204	183	144	92	45
PENASCO	182	165	131	86	44
PICURIS	248	224	176	112	55
QUESTA	217	199	160	106	53
TAOS	970	878	696	448	219
TAOS PUEBLO	265	246	204	140	74
TRES PIEDRAS	50	48	34	19	8
	2144	1943	1545	1003	498
URBAN PLACES					
RATON	706	634	496	314	151
LOS ALAMOS	173	140	92	47	17
ESPANOLA	387	343	249	163	76
LAS VEGAS	1748	1604	1303	867	441
SANTA FE	2969	2646	2042	1265	590

TABLE 6: NUMBER OF PERSONS WILLING TO COMMUTE SPECIFIED TIMES FOR $4.00 AN HOUR, BY CENSUS UNIT.

CENSUS UNIT	COMMUTING TIME, ONE WAY, IN MINUTES UP TO 15	UP TO 30	UP TO 60	UP TO 90	OVER 90
CENSUS COUNTY DIVISIONS					
COLFAX COUNTY					
CIMARRON	257	224	165	96	42
RATON	49	41	28	15	6
SPRINGER	393	336	242	136	56
	699	601	435	247	104
MORA COUNTY					
MORA	500	450	355	226	109
WAGON MOUND	379	344	271	172	82
	879	794	626	398	191
RIO ARRIBA COUNTY					
ALCALDE	594	550	454	310	163
CHIMAYO	457	425	355	246	132
COYOTE	259	238	195	132	70
DIXON	231	217	183	129	71
ESPANOLA	472	413	311	189	87
JICARILLA	314	282	222	143	71
RIO CHAMA	309	292	250	179	100
TIERRA AMARILLA	401	368	298	198	100
VALLECITAS	149	145	132	105	68
	3186	2930	2400	1631	862
SAN MIGUEL COUNTY					
CONCHAS DAM	54	47	35	21	9
LAS VEGAS NORTH	265	246	204	139	73
LAS VEGAS SOUTHEAST	127	102	67	34	13
PECOS	363	336	277	190	101
TREMENTINA	66	61	49	33	17
VILLANUEVA	360	327	261	169	83
	1235	1119	893	586	296
SANTA FE COUNTY					
POJOAQUE	207	185	143	89	41
SAN CRISTOVAL	71	57	37	19	7
SAN ILDEFONSO	184	170	141	95	49
SAN SEBASTIAN	338	303	237	150	72
SANTA CRUZ	251	218	162	96	43
SANTA FE	268	243	194	125	61
TESUQUE	178	163	131	86	43
	1497	1339	1045	660	316
TAOS COUNTY					
ARROYO HONDO	244	223	181	121	62
PENASCO	206	192	161	112	60
PICURIS	297	272	221	146	74
QUESTA	348	314	249	161	80
TAOS	1156	1061	859	567	284
TAOS PUEBLO	305	285	240	169	92
TRES PIEDRAS	66	58	44	26	12
	2622	2405	1955	1302	664
URBAN PLACES					
RATON	1104	1003	799	517	253
LOS ALAMOS	358	287	187	93	34
ESPANOLA	539	482	375	236	113
LAS VEGAS	2069	1924	1597	1092	573
SANTA FE	4334	3911	3074	1948	930

TABLE 7: MEAN WILLINGNESS TO COMMUTE, BY CENSUS UNIT.

CENSUS UNIT	REWARD LEVEL IN DOLLARS PER MONTH 0 TO 50	50 TO 150	150 TO 250	OVER 250
CENSUS COUNTY DIVISIONS				
COLFAX COUNTY				
CIMARRON	1.42	2.30	2.84	3.16
RATON	1.31	2.06	2.62	2.97
SPRINGER	1.46	2.28	2.78	3.04
MORA COUNTY				
MORA	1.26	2.16	2.84	3.42
WAGON MOUND	1.79	2.64	3.24	3.38
RIO ARRIBA COUNTY				
ALCALDE	2.10	2.99	3.54	3.75
CHIMAYO	1.82	2.71	3.40	3.77
COYOTE	1.74	2.63	3.29	3.74
DIXON	2.17	3.05	3.67	3.86
ESPANOLA	1.2[illegible]	2.11	2.72	3.37
JICARILLA	1.[illegible]	2.90	3.47	3.68
RIO CHAMA	2.12	3.04	3.67	3.91
TIERRA AMARILLA	1.98	2.89	3.41	3.63
VALLECITAS	2.86	3.7[illegible]	4.29	4.37
SAN MIGUEL COUNTY				
CONCHAS DAM	1.66	2.45	2.94	3.18
LAS VEGAS NORTH	2.29	3.16	3.69	3.76
LAS VEGAS SOUTHEAST	.30	1.08	1.78	2.61
PECOS	1.85	2.77	3.39	3.77
TREMENTINA	1.66	2.50	3.11	3.55
VILLANUEVA	1.34	2.30	2.92	3.47
SANTA FE COUNTY				
POJOAQUE	1.82	2.73	3.22	3.40
SAN CRISTOVAL	1.15	1.94	2.39	2.67
SAN ILDEFONSO	2.26	3.20	3.68	3.61
SAN SEBASTIAN	1.89	2.77	3.26	3.49
SANTA CRUZ	1.58	2.46	2.99	3.36
SANTA FE	2.18	3.04	3.56	3.55
TESUQUE	2.23	3.10	3.51	3.55
TAOS COUNTY				
ARROYO HONDO	1.73	2.62	3.25	3.63
PENASCO	1.67	2.57	3.26	3.77
PICURIS	1.56	2.47	3.13	3.58
QUESTA	1.95	2.91	3.45	3.63
TAOS	1.87	2.77	3.34	3.56
TAOS PUEBLO	2.04	2.99	3.59	3.81
TRES PIEDRAS	.86	1.58	2.30	3.08
URBAN PLACES				
RATON	2.02	2.92	3.42	3.59
LOS ALAMOS	1.53	2.30	2.55	2.67
ESPANOLA	1.85	2.76	3.2[illegible]	3.48
LAS VEGAS	2.11	2.99	3.54	3.70
SANTA FE	2.03	2.89	3.37	3.47

Table 8. Number of employed persons, 16 years and over in Northcentral New Mexico, by occupation

Census Unit	PROFESSIONAL AND TECHNICAL						
	Engineers	Physicians	Other Health Workers	Teachers	Technicians	Other	Total
CENSUS COUNTY DIVISIONS							
Colfax County	0	17	0	54	0	84	155
Cimarron	0	5	0	9	0	13	27
Raton	0	0	0	13	0	0	13
Springer	0	12	0	32	0	71	115
Mora County	0	7	0	49	0	29	85
Mora	0	7	0	24	0	23	54
Wagon Mound	0	0	0	25	0	6	31
Rio Arriba County	23	18	12	261	119	229	662
Alcalde	6	4	0	44	15	47	116
Chimayo	0	0	0	9	5	27	41
Coyote	5	0	0	16	8	16	45
Dixon	0	0	0	35	5	0	40
Espanola	0	3	8	16	49	47	123
Jicarilla	0	11	4	54	6	33	108
Rio Chama	5	0	0	43	0	6	54
Tierra Amarilla	7	0	0	20	31	34	92
Vallecitas	0	0	0	24	0	19	43
San Miguel County	7	13	26	66	33	136	281
Conchas Dam	0	0	0	0	0	0	0
Las Vegas North	4	13	18	25	23	76	159
Las Vegas Southeast	0	0	8	16	10	32	66
Pecos	3	0	0	16	0	26	45
Trementina	0	0	0	9	0	0	9
Villanueva	0	0	0	0	0	2	2
Santa Fe County	69	25	67	200	84	343	778
Pojoaque	0	8	12	34	23	40	117
San Cristoval	7	0	0	0	0	27	34
San Ildefonso	0	0	13	8	30	40	91
San Sebastian	11	7	18	50	5	73	164
Santa Cruz	17	4	9	48	10	45	133
Santa Fe	17	6	5	35	16	54	133
Tesuque	17	0	10	25	0	64	106
Taos County	29	0	30	363	47	354	823
Arroyo Hondo	0	0	0	43	0	33	76
Penasco	0	0	0	14	0	10	24
Picuris	4	0	9	26	12	25	76
Questa	0	0	0	92	7	57	156
Taos	25	0	16	148	24	204	417
Taos Pueblo	0	0	5	36	4	25	70
Tres Piedras	0	0	0	4	0	0	4
URBAN PLACES							
Raton	4	11	11	83	15	196	320
Los Alamos	658	43	109	289	607	1645	3351
Espanola	17	20	25	119	24	79	284
Las Vegas	14	33	116	183	35	357	738
Santa Fe	235	132	281	671	284	1828	3431

and census unit, 1970.

MANAGERS AND ADMINISTRATORS						SALES WORKERS			
Salaried			Self-employed						
Manufacturing	Retail Trade	Other	Retail Trade	Other	Total	Manufacturing	Retail Trade	Other	Total
4	18	116	33	26	197	5	9	6	20
0	11	27	5	15	58	5	4	0	9
0	0	5	0	0	5	0	0	0	0
4	7	84	28	11	134	0	5	6	11
0	7	70	30	0	107	0	4	0	4
0	7	35	18	0	60	0	0	0	0
0	0	35	12	0	47	0	4	0	4
10	16	196	22	24	268	17	107	38	162
5	0	61	6	14	86	12	26	5	43
0	0	18	10	0	28	5	0	0	5
0	0	6	0	0	6	0	0	6	6
0	0	5	0	0	5	0	5	0	5
0	5	25	0	0	30	0	22	5	27
0	5	27	6	0	38	0	7	10	17
0	0	22	0	0	22	0	9	5	14
5	6	25	0	0	36	0	32	0	32
0	0	7	0	10	17	0	6	7	13
0	0	73	18	7	98	0	26	10	36
0	0	0	0	0	0	0	0	5	5
0	0	47	18	7	72	0	16	5	21
0	0	16	0	0	16	0	0	0	0
0	0	0	0	0	0	0	10	0	10
0	0	10	0	0	10	0	0	0	0
0	0	0	0	0	0	0	0	0	0
23	54	197	54	68	393	16	146	55	217
0	3	19	18	4	44	10	13	5	28
0	0	3	5	5	13	0	0	4	4
0	0	20	6	0	26	0	24	0	24
0	16	76	0	18	110	0	51	23	74
0	11	27	13	14	65	0	17	0	17
23	14	0	0	10	47	6	13	14	33
0	7	52	12	17	88	0	28	9	37
22	57	224	88	77	468	36	120	30	186
0	0	24	0	0	24	0	11	0	11
0	0	14	5	9	28	0	0	0	0
0	0	17	6	0	23	0	8	0	8
5	8	41	23	39	116	10	9	0	19
17	35	101	54	29	236	26	77	30	133
0	14	12	0	0	26	0	15	0	15
0	0	15	0	0	15	0	0	0	0
36	48	121	69	42	316	13	74	12	99
10	71	264	12	15	372	41	201	33	275
3	59	48	20	19	149	7	71	7	85
12	71	194	51	43	371	9	118	15	142
41	306	954	199	111	1611	148	608	204	960

Table 8. Continued

Census Unit	TRANSPORT OPERATIVES			LABORERS EXCEPT FARM				
	Truck Drivers	Other Transport	Total	Construction	Freight	Other	Total	Owners & Managers
CENSUS COUNTY DIVISIONS								
Colfax County	44	19	63	32	40	39	111	165
Cimarron	16	6	22	11	31	17	59	45
Raton	11	6	17	0	4	8	12	22
Springer	17	7	24	21	5	14	40	98
Mora County	44	26	70	65	8	31	104	78
Mora	25	7	32	10	8	23	41	23
Wagon Mound	19	19	38	55	0	8	63	55
Rio Arriba County	76	217	293	236	23	181	440	121
Alcalde	12	15	27	32	4	11	47	35
Chimayo	5	12	17	44	5	21	70	6
Coyote	0	18	18	0	0	6	6	5
Dixon	16	15	31	11	0	5	16	5
Expanola	18	40	58	16	8	26	50	4
Jicarilla	5	54	59	35	0	14	49	17
Rio Chama	0	34	34	10	0	26	36	6
Tierra Amarilla	12	15	27	88	6	59	153	43
Vallecitas	8	14	22	0	0	13	13	0
San Miguel County	21	51	72	43	16	75	134	69
Conchas Dam	0	0	0	0	0	6	6	0
Las Vegas North	14	0	14	4	0	12	16	22
Las Vegas Southeast	4	0	4	0	8	8	16	22
Pecos	3	13	16	24	8	37	69	5
Trementina	0	0	0	6	0	5	11	5
Villanueva	0	38	38	9	0	7	16	15
Santa Fe County	65	35	100	53	29	69	151	66
Pojoaque	0	10	10	0	5	11	16	5
San Cristoval	0	0	0	3	0	11	14	41
San Ildefonso	5	0	5	13	5	0	18	0
San Sebastian	32	7	39	10	0	10	20	10
Santa Cruz	6	0	6	21	4	0	25	7
Santa Fe	11	0	11	0	10	6	16	0
Tesuque	11	18	29	6	5	31	42	4
Taos County	146	142	287	39	51	110	200	63
Arroyo Hondo	26	13	39	0	0	9	9	9
Penasco	6	0	6	0	0	0	0	0
Picuris	0	23	23	4	5	9	18	0
Questa	57	19	76	10	5	16	31	17
Taos	47	62	108	21	23	58	102	26
Taos Pueblo	10	25	35	4	18	18	40	5
Tres Piedras	0	0	0	0	0	0	0	6
URBAN PLACES								
Raton	61	58	119	52	16	59	127	37
Los Alamos	6	66	72	26	56	15	97	5
Espanola	4	12	16	10	37	15	62	3
Las Vegas	75	63	138	48	49	36	133	20
Santa Fe	146	249	395	111	108	293	512	48

FARMERS			SERVICE WORKERS							PRIVATE HOUSEHOLD
Unpaid Family Laborers	Other	Total	Cleaning	Food	Health	Personal	Protective	Service	Total	
6	107	278	46	8	16	16	30	11	199	8
0	71	116	6	38	0	5	0	6	55	0
0	12	34	10	4	0	0	0	0	14	4
6	24	128	30	38	16	11	30	5	130	4
0	101	179	26	28	0	0	15	8	77	28
0	53	76	0	19	0	0	0	0	19	3
0	48	103	26	9	0	0	15	8	58	25
12	108	241	216	169	65	82	51	153	736	---
0	27	62	47	42	11	16	14	49	179	53
0	0	6	25	6	13	5	0	3	52	34
0	24	29	7	4	5	0	4	6	26	4
0	0	5	14	23	4	11	0	22	74	11
0	0	4	55	22	23	7	10	23	140	23
12	0	29	16	23	9	20	14	19	101	9
0	24	30	48	21	0	15	0	0	84	0
0	33	76	4	23	0	0	9	31	67	13
0	0	0	0	5	0	8	0	0	13	0
45	124	238	103	61	46	6	3	11	230	35
38	4	42	3	0	0	0	0	0	3	5
7	8	37	24	33	27	6	0	0	90	14
0	33	55	16	7	10	0	0	0	33	0
0	32	37	56	13	0	0	0	11	80	16
0	17	22	0	0	0	0	0	0	0	0
0	30	45	4	8	9	0	3	0	24	0
0	84	150	144	156	49	76	83	63	571	148
0	18	23	3	10	13	0	20	6	52	22
0	34	75	0	4	0	9	0	0	13	0
0	0	0	37	38	15	30	5	12	137	44
0	19	29	37	26	15	4	8	0	90	11
0	6	13	25	22	6	15	16	22	106	0
0	0	0	19	46	0	18	24	0	107	12
0	7	11	23	10	0	0	10	23	66	59
0	69	132	125	168	4	105	37	72	511	159
0	4	13	0	14	4	18	0	0	36	20
0	16	16	10	5	0	0	0	0	15	3
0	0	0	6	13	0	5	0	5	29	0
0	11	28	5	28	0	25	0	24	82	9
0	25	51	61	75	0	38	32	30	236	88
0	13	18	35	15	0	12	5	13	80	39
0	0	6	8	18	0	7	0	0	33	0
0	12	49	10	4	0	0	0	0	14	4
6	8	19	56	104	5	68	84	22	339	31
0	5	8	38	53	10	22	18	14	155	10
4	11	35	218	253	357	150	11	130	1119	28
0	21	69	487	755	176	230	234	377	2259	381

Table 8. Continued

Census Unit	CLERICAL					
	Bookkeepers	Secretaries	Other	Total	Auto Mechanics	Other Mechanics
CENSUS COUNTY DIVISIONS						
Colfax County	31	52	87	170	11	8
Cimarron	10	12	10	32	5	4
Raton	10	12	10	32	0	0
Springer	11	28	67	106	6	4
Mora County	21	15	30	66	0	0
Mora	12	15	9	36	0	0
Wagon Mound	9	0	21	30	0	0
Rio Arriba County	19	221	434	674	77	51
Alcalde	0	37	97	134	45	5
Chimayo	0	50	36	86	0	0
Coyote	0	10	34	44	0	0
Dixon	11	5	49	65	0	8
Espanola	0	66	62	128	16	15
Jicarilla	0	18	34	52	5	5
Rio Chama	0	20	29	49	11	12
Tierra Amarilla	8	8	82	98	0	6
Vallecitas	0	7	11	18	0	0
San Miguel County	11	22	100	133	33	33
Conchas Dam	0	0	15	15	0	0
Las Vegas North	11	18	38	67	15	29
Las Vegas Southeast	0	4	9	13	4	0
Pecos	0	0	31	31	14	4
Trementina	0	0	0	0	0	0
Villanueva	0	0	7	7	0	0
Santa Fe County	54	144	315	513	38	58
Pojoaque	7	19	31	57	7	0
San Cristoval	5	14	17	36	5	4
San Ildefonso	0	19	55	74	12	5
San Sebastian	10	30	47	87	11	21
Santa Cruz	12	9	42	63	0	0
Santa Fe	0	29	93	122	3	28
Tesuque	20	24	30	74	0	0
Taos County	92	160	287	529	61	144
Arroyo Hondo	0	22	16	38	0	6
Penasco	0	12	0	12	0	0
Picuris	4	18	13	25	4	0
Questa	12	0	27	39	11	60
Taos	51	89	212	352	34	72
Taos Pueblo	25	13	19	57	12	6
Tres Piedras	0	6	0	6	0	0
URBAN PLACES						
Raton	67	88	192	347	79	29
Los Alamos	57	436	411	904	33	114
Espanola	16	45	150	211	12	14
Las Vegas	53	187	433	673	46	48
Santa Fe	361	870	2000	3231	133	159

CRAFTSMEN						OPERATIVES			
Machinists	Metal Craftsmen	Carpenters	Construction Craftsmen	Other	Total	Durable Goods	Nondurable Goods	Non-manufacturing	Total
5	0	27	60	87	198	39	0	54	93
0	0	16	10	28	63	39	0	11	50
0	0	0	0	6	6	0	0	14	14
5	0	11	50	53	129	0	0	29	29
0	0	24	45	13	82	7	0	16	23
0	0	14	21	4	39	7	0	7	14
0	0	10	24	9	43	0	0	9	9
20	15	98	175	298	734	78	48	291	395
6	11	18	17	101	203	8	16	46	70
0	4	10	26	38	78	4	5	24	33
0	0	12	5	0	17	0	0	16	16
0	0	6	5	15	34	0	0	20	20
14	0	6	39	54	147	11	11	51	73
0	0	21	27	53	111	27	0	77	104
0	0	0	18	3	44	6	5	13	24
0	0	19	38	31	94	0	0	38	38
0	0	6	0	0	6	0	11	6	17
0	0	46	56	35	203	0	9	139	148
0	0	0	0	5	5	0	0	0	0
0	0	6	34	30	114	0	0	26	26
0	0	16	0	0	20	0	0	0	0
0	0	7	9	0	34	0	0	69	69
0	0	0	5	0	5	0	0	5	5
0	0	17	8	0	25	0	9	39	48
18	5	47	131	180	477	37	35	164	236
5	0	6	30	20	68	4	0	23	27
0	0	0	0	5	14	0	0	26	26
5	0	9	0	34	65	6	13	31	50
0	0	15	27	45	119	5	7	30	42
8	5	6	26	10	55	6	15	21	42
0	0	4	30	36	101	16	0	17	33
0	0	7	18	30	55	0	0	16	16
0	0	105	178	163	651	41	118	350	509
0	0	10	18	4	38	0	0	49	49
0	0	0	9	8	17	0	13	8	21
0	0	4	0	0	8	0	0	8	8
0	0	14	63	49	197	9	13	148	170
0	0	45	54	76	281	18	19	87	124
0	0	32	34	19	103	0	73	44	117
0	0	0	0	7	7	14	0	6	20
17	0	41	69	184	419	59	4	254	317
136	36	10	113	167	609	0	4	140	144
0	16	5	74	73	194	19	39	51	109
11	5	69	91	125	395	4	17	149	170
39	44	136	324	578	1413	27	50	425	502

Labor Market Areas for the Six Principal Urban Areas - NCNM

Maps 2 through 7 delineate the 60 minute commuting zones around each of the principal urban areas in NCNM. These may be interpreted as reasonable labor market boundaries for each of the communities noted. Beside each map is a table indicating the potential number of non-resident commuters within the boundary at each of the wage levels indicated. For example, from map 2, Espanola has a potential non-resident commuting labor supply of 3,345 people within 60 minutes of the city. The Espanola labor supply, of course, will be larger than this as the city's own labor resources have not been counted. An increase in annual wage level to $3.00 per hour would result in an additional 3,635 (up to the 6970 total) workers willing to commute into Espanola for employment.

The Espanola, Los Alamos, Santa Fe, and Taos areas appear to have an abundance of willing commuters at all wage rates. The Las Vegas situation is comparable but with fewer numbers of persons willing to commute into the city for employment. Raton, being somewhat isolated from the rest of the region, has considerably fewer persons willing to commute into the city for employment.

Scope and Limitations

The results are specific to north-central New Mexico. The willingness to commute relationships were developed from information about north-central New Mexico residents and may or may not reflect expected behavior of residents of other regions. The results may be applicable in southern Colorado, parts of southern New Mexico and areas in Texas having similar socio-economic characteristics.

Care should be taken when interpreting the maps to guard against overstatement of potential labor supply within the region. Utilization of a 60 minute driving time results in considerable overlap of labor market areas, hence, many of the potential commuters to one area have also been counted as potential commuters to another urban place. For planning purposes, the maps provide a means of identifying the target population if job opportunities are created to alleviate rural unemployment and underemployment conditions.

The estimating equation is limited in that it is not possible to pinpoint the occupation or skill level of those willing to commute to new job opportunities. It is necessary to presume this is in large part dictated by the occupations of the potential commuters. Therefore, to supplement the basic results, a table summarizing the number of residents in each occupation by county census is included as table 8. If, as indicated in table 5, 194 Cimarron residents are willing to commute up to 15 minutes one way for $3.00 per hour, a glance at table 8 suggests a majority of these commuters will be craftsmen and operatives.

There is, of course, reason to believe that many of these commuters may be trained or retrained to fill the needs of most new or expanding industries. There is a public vocational training facility in the area affecting a wide and flexible range of occupational training programs. The experience of Alcoa Corporation at Chimayo is an example of the willingness of the labor force to commute and to train for available opportunities. An advertisement for assemblers, to be paid $2.00 per hour for no experience, yielded 300 applications for less than 50 positions. Alcoa apparently has been successful in training individuals to assemble the company product-care modular for homes as the firm plans relocation within the region and expansion of the operation in the near future.

TECHNICAL APPENDIX

This explanation of methodology begins by illustrating the steps leading to one of the numbers in tables 1-3; it concludes with a succinct mathematical description of the general process this example illustrates. The process, both specific and general, utilizes reasonable approximations at several points.

The predictive equations used in this study were developed from data in the previously cited study by Carruthers, Urquhart, Eastman, and Gomez. That earlier study ascertained expressed willingness to commute in response to raises in household income of $0, $100, $200, $300 per month. (Call these reward levels.) For purposes of this study, then, the income distribution in each census unit must be translated into these raises for each wage level. Separately, the mean willingness to commute is evaluated at each reward level in each census unit, based on values of regression variables in that census unit. The final estimates result from properly combining the distribution across reward levels with the mean willingness to commute.

For example, table 3 gives the number of people willing to commute up to 30 minutes (second data column) in the Mora census county division of Mora County (fifth data row) as 314 at a wage level of $2.25 in 1969-70 dollars. To verify this number, first answer this question: What distribution across reward levels does $2.25 induce? In table 9 the Mora census county division has 114,

TABLE 9: INCOME DISTRIBUTION IN NORTHCENTRAL NEW MEXICO, BASED ON 1970 CENSUS DATA.* (NUMBER OF HOUSEHOLDS).

	UPPER LIMIT OF INCOME CLASS, IN THOUSANDS OF DOLLARS												
CENSUS UNIT	1	2	3	4	5	6	7	8	9	10	12	15	25
CENSUS COUNTY DIVISIONS													
COLFAX COUNTY													
CIMARRON	33	17	43	19	51	52	38	21	34	9	17	16	30
RATON		5		5	7	19	14	4	10	5	7		17
SPRINGER	31	52	41	52	61	76	67	44	72	71	42	73	42
	64	74	84	76	119	147	119	69	116	85	66	89	89
MORA COUNTY													
MORA	114	90	98	74	46	35	42	24	17	8	18	15	5
WAGON MOUND	105	39	70	41	39	37	45	18	31	4	23		9
	219	129	168	115	85	72	87	42	48	12	41	15	14
RIO ARRIBA COUNTY													
ALCALDE	58	94	104	67	94	45	80	70	42	67	86	54	40
CHIMAYO	129	65	51	42	83	45	17	38	25	21	38	17	
COYOTE	45	14	65	34	41	13	28	28	18	4	10	3	11
DIXON	66	34	20	20	28	25	25	18	18	9	16	31	
ESPANOLA	37	55	85	72	67	78	54	60	41	55	45	42	25
JICARILLA	37	14	45	16	47	29	57	85	49	16	40	54	49
RIO CHAMA	83	56	53	36	10	36	27	13	20	18	38	22	21
TIERRA AMARILLA	26	105	51	56	40	38	49	51	42	43	54	70	21
VALLECITAS	31	12	38	23	18	17	6	4					
	512	449	512	366	428	326	343	367	255	233	328	293	167
SAN MIGUEL COUNTY													
CONCHAS DAM			10	5	23	5	3	11					6
LAS VEGAS NORTH	20	32	51	10	35	33	70	20	48	4	43	4	40
LAS VEGAS SOUTHEAST	11	23	46	14	15	18	17		15		4	8	
PECOS	34	77	73	49	39	29	39	34	42	19	6	9	8
TRUCHAS	10	12	10	10	17			10		7	4	4	4
VILLANUEVA	66	84	56	63	45	22	14	25	4			4	
	141	228	246	151	174	107	143	100	109	30	57	29	58
SANTA FE COUNTY													
POJOAQUE	12	18	6	37	43	35	36	31	27	7	12	37	39
SAN CRISTOVAL	14		4	14	20	5		24	14	10	8		21
SAN ILDEFONSO	16	29	23	11	41	24	32	12	37	22	62	23	35
SAN SEBASTIAN	17	58	32	47	54	42	47	57	30	32	61	49	87
SANTA CRUZ	37	25	21	20	19	47	54	46	34	17	53	21	27
SANTA FE		12	40	21	35	58	65	47	20	15	29	33	38
TESUQUE	21	5	24	25	28	24	37	19	30	16	10	52	68
	117	147	150	175	240	235	271	236	192	119	235	215	315
TAOS COUNTY													
ARROYO HONDO	37	48	30	30	37	32	18	20	22	34	16	22	4
PENASCO	5	53	42	27	42	22	14	6	9	15	9		11
PICURIS	5	91	44	63	39	17	43	4	28		6	9	8
QUESTA	9	72	50	34	32	28	64	76	63	97	115	45	94
TAOS	175	173	212	183	130	140	95	80	149	74	120	114	82
TAOS PUEBLO	69	46	45	52	26	35	11	28	18	57	20	38	6
TRES PIEDRAS	12		22	15	15		5		7	8			
	312	483	445	404	321	274	251	222	296	285	286	227	205
URBAN PLACES													
RATON	47	94	144	136	159	182	270	136	138	93	119	175	162
LOS ALAMOS	25	30	29	15	48	40	77	136	149	182	468	677	1629
ESPANOLA	57	67	61	65	62	99	36	121	80	82	100	66	82
LAS VEGAS	237	401	301	340	267	265	150	164	163	125	209	151	170
SANTA FE	371	369	499	521	662	710	728	569	588	581	1102	1069	1231

*SOURCE: U.S. BUREAU OF THE CENSUS, FOURTH COUNT SUMMARY TAPES, FILES B AND C, GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C., 1970.

90, 98, 74 and 46 in the columns for income levels of $0-$1000, 1000-2000, 2000-3000, 3000-4000, 4000-5000. An hourly wage of $2.25 would yield a yearly income of about $4,500 per year (year = 2000 working hours, approximately). The original reward levels of $0, 100, 200 and 300 per month were approximated by the ranges of $0-50, 50-150, 150-250, and over 250 per month or $0-600, 600-1800, 1800-3000, and over 3000 per year. Thus, yearly wages of $3900-4500 correspond to no raise, $2700-3900 to $100 per month, $1500-3900 to $200 per month, under $1500 to $300 or more per month. When combined, the following results:

Reward Levels ($/mo.)	0	100	200	300
Number of Families	30.4	96.0	113.6	159

For example, the number of 96 for a reward level of $100/mo. results from approximately the number of households in the income range of $2700-3900 by

$$\left(\frac{3000-2700}{1000}\right)98 + \left(\frac{3900-3000}{1000}\right)74 = (0.3)\,(98) + (0.9)\,(74) = 96.$$

The other values were approximated in the same fashion.

Table 7 gives the respective mean willingness to commute of these households as 1.26, 2.16, 2.84, 3.42 on a 5 point scale. These were obtained by using values of the socio-economic variables shown in table 11 (obtained from census data) times the regression coefficients in table 10 (obtained from regression analyses of data in the background study). For example:

$$2.16 = 2.98984 + (0.90407)\,(0.081) + (-0.08108)(7.45) + \ldots + (.00006)\,(3225).$$

Figure 5 shows these four distributions with the means given above, and standard deviations shown as square roots of the variances given at the bottom of table 10 (for example, $\sqrt{2.211} = 1.487$). In each of the distributions, the proportion of households having a head who will commute up to 30 minutes (score of at least 1.5) is shaded. For example, the second distribution applies to the 96 households for which $2.25/hr. would give an increase in income of $50-150 per month, or $600-1800 per year. Reference to tables of the standard normal distribution gives the shaded proportion as the normal probability above the standardized point $\frac{1.5 - 2.16}{1.487} = -0.444$ as 0.6714. This says that approximately 67% of the 96 families, i.e., 64.5, have a head who will commute at least 30 minutes. The other reward levels similarly yield 13.1, 93.2 and 143.0, respectively. Their sum, rounded, gives the 314 referred to earlier.

TABLE 10: ESTIMATED VALUES OF THE REGRESSION COEFFICIENTS, BY REWARD LEVEL, AND ESTIMATES OF RESIDUAL VARIABILITY.

VARIABLE NUMBER AND NAME	REWARD LEVEL, DOLLARS PER MONTH 0 TO 50	50 TO 150	150 TO 250	>250
0. CONSTANT TERM	2.12347	2.98984	3.88176	4.55637
1. PROPORTION HAVING WORKED OUT OF COUNTY BEFORE	-.96481	-.90407	-.75099	-.69656
2. AVERAGE YEARS OF EDUCATION	-.04806	-.08108	-.08075	-.06798
3. PROPORTION OF FAMILIES HAVING SMALL CHILDREN	-.61724	-.53654	-.31288	-.22382
4. PROPORTION OF FAMILIES HAVING EMPLOYMENT	1.16825	1.26048	1.14626	.52812
5. PROPORTION OF SALES WORKERS	.71182	1.02644	.74201	.60562
6. PROPORTION OF CRAFTSMEN	.28273	.38468	.53907	.66015
7. PROPORTION OF OPERATIVES (MACHINERY)	-.46907	-.72312	-.92524	-.96960
8. AVERAGE NUMBER OF WEEKS WORKED	-.02777	-.01999	-.02250	-.01780
9. AVERAGE HOUSEHOLD INCOME	-.00004	-.00004	-.00007	-.00006
10. AVERAGE DEPENDENCY RATIO	-.82011	-.97086	-.93064	-1.05002
11. PROPORTION OF FAMILIES OWNING HOME	-.19855	-.22003	-.24487	-.26681
12. PROPORTION OF FAMILIES HAVING AUTOS	.72403	.61446	.63051	.45475
13. PROPORTION OF FARM LABOR LIVING IN COUNTRY	-1.70912	-2.39906	-2.78520	-2.90458
14. PROPORTION OF SPANISH-AMERICAN MANAGERS	-.45666	-.43077	-.43451	-.40966
15. PROPORTION OF SPANISH-AMERICAN OPERATIVES	-.53730	-.51836	-.51201	-.50811
16. AVERAGE OF SPANISH-AMERICAN TIMES INCOME	.00005	.00006	.00006	.00005
RESIDUAL MEAN SQUARES	2.51900	2.21100	2.16200	2.28600

TABLE 11: VALUES OF VARIABLES USED IN ESTIMATING MEAN WILLINGNESS TO COMMUTE.

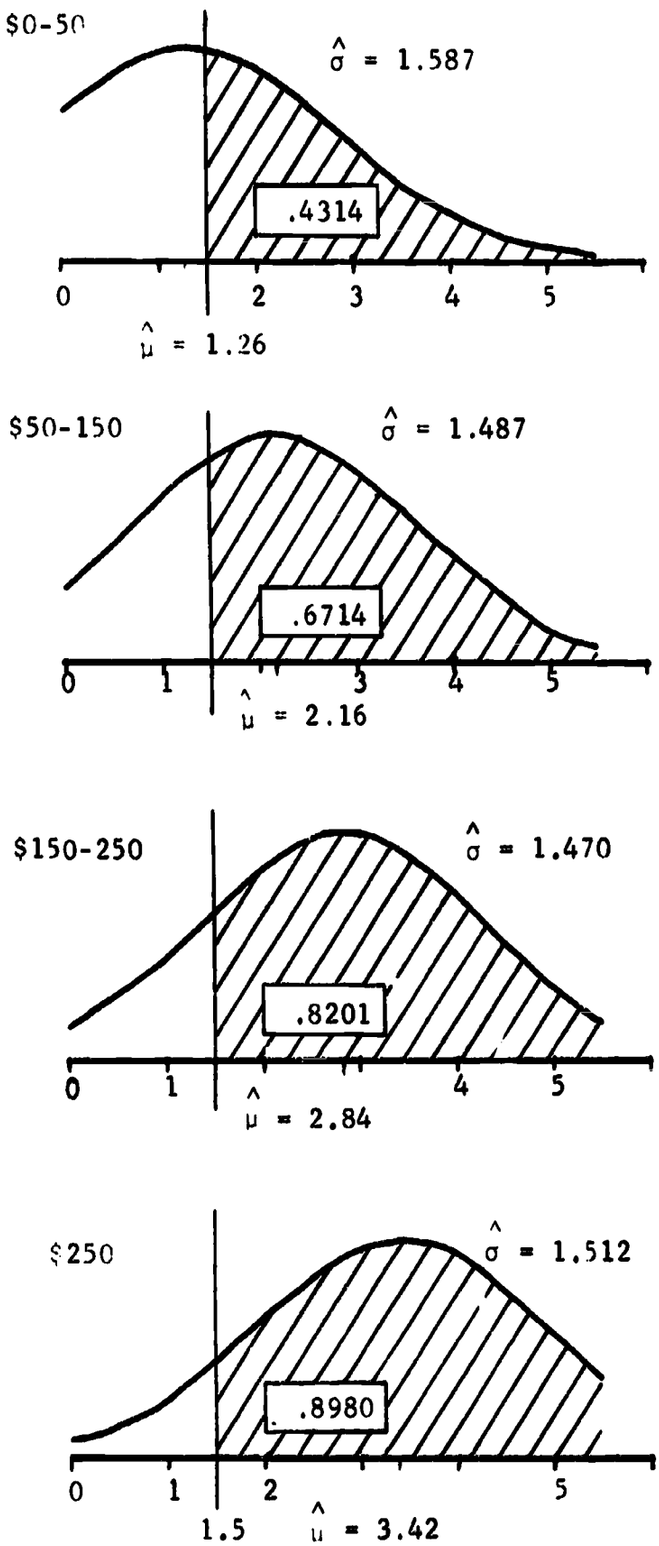
CENSUS UNIT	VARIABLE NUMBERS, NAMES GIVEN AT BOTTOM OF TABLE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CENSUS COUNTY DIV.																
COLFAX COUNTY																
CIMARRON	.041	9.69	.187	.919	.017	.118	.135	42.10	6614	.284	.483	.639	.084	.028	.103	3397
RATON	.032	10.28	.108	.816		.032	.167	36.42	5285	.322	.870	.567	.119			2450
SPRINGER	.032	10.12	.230	.982	.013	.149	.061	42.26	7472	.282	.708	.819	.113	.119	.032	4443
MORA COUNTY																
MORA	.081	7.45	.232	.445		.046	.055	34.66	3872	.118	.678	.452	.027	.160	.039	3225
WAGON MOUND	.133	8.20	.310	1.027	.009	.095	.104	38.52	4274	.302	.859	.850	.122	.104	.097	3956
RIO ARRIBA COUNTY																
ALCALDE	.225	8.72	.231	.988	.005	.192	.092	37.46	6491	.242	.831	.856	.033	.043	.087	5127
CHIMAYO	.046	7.51	.273	.694	.011	.120	.077	31.60	4400	.165	.846	.721	.009	.022	.062	3736
COYOTE	.106	7.03	.265	.575	.016	.045	.090	30.98	4886	.137	.756	.634	.013	.016		3256
DIXON	.260	8.54	.326	.959	.016	.106	.160	32.38	5154	.265	.922	.837	.016	.016	.160	3897
ESPANOLA	.066	8.49	.112	.391	.013	.073	.065	36.61	6333	.189	.347	.349	.002	.002	.046	4801
JICARILLA	.248	9.80	.433	1.125	.025	.164	.241	35.83	8000	.256	.528	.678	.025	.029	.156	2946
RIO CHAMA	.111	7.70	.257	.823	.029	.093	.122	33.86	5133	.214	.857	.914	.013	.046	.118	5822
TIERRA AMARILLA	.287	8.63	.327	.962	.042	.124	.086	41.44	6669	.260	.754	.861	.057	.018	.077	5391
VALLECITAS	.617	8.61	.161	1.087	.080	.037	.241	25.62	3972	.288	.550	.577		.055	.241	3040
SAN MIGUEL COUNTY																
CONCHAS DAM	.170	9.67	.193	.989	.057	.057		39.40	6277	.333	.534	.750	.068			777
LAS VEGAS NORTH	.046	9.14	.250	1.212	.033	.181	.063	31.59	7164	.218	.773	.833	.035	.060	.063	4233
LAS VEGAS S.E.		8.33	.296			.082	.018	43.20	4447	.318	.728	.805	.099	.072		2635
PECOS	.271	8.08	.189	.740	.018	.062	.154	32.83	4836	.184	.695	.414	.009		.154	3902
TRUCHAS	.050	7.12	.118	.521		.042	.042	32.43	5443	.179	.748	.773	.042	.050	.042	4627
VILLANUEVA	.052	5.84	.298	.488		.059	.205	34.12	7563	.120	.779	.652	.036		.202	2938
SANTA FE COUNTY																
POJOAQUE	.067	10.35	.286	1.134	.060	.146	.080	40.46	8051	.293	.807	.782	.011	.058	.080	4459
SAN CRISTOVAL	.030	10.89	.254	1.041	.017	.061	.113	46.19	7878	.292	.527	.677	.179		.030	2967
SAN ILDEFONSO	.028	9.81	.261	1.439	.045	.122	.103	39.11	8114	.410	.892	.863		.043	.088	6248
SAN SEBASTIAN	.055	10.58	.235	1.033	.094	.151	.103	38.14	8447	.230	.766	.861	.013	.037	.041	3536
SANTA CRUZ	.105	10.16	.217	.831	.027	.087	.076	39.67	7305	.232	.667	.690	.011	.057	.030	4148
SANTA FE	.067	11.53	.408	1.411	.054	.164	.071	39.09	7941	.381	.674	.995		.034	.047	4031
TESUQUE	.246	10.82	.256	1.275	.062	.093	.076	39.91	9430	.363	.789	.931	.007	.054	.076	5811
TAOS COUNTY																
ARROYO HONDO	.063	9.23	.208	.743	.023	.080	.185	35.10	5551	.195	.867	.731	.019	.040	.139	4255
PENASCO	.043	8.61	.204	.438		.052	.083	27.16	4962	.112	.802	.574		.071	.083	5049
PICURIS	.079	8.01	.286	.603	.021	.021	.092	35.05	4550	.152	.894	.627		.061	.058	4378
QUESTA	.141	10.07	.362	1.133	.020	.213	.266	38.71	8793	.294	.827	.822	.018	.063	.266	6306
TAOS	.090	9.88	.222	1.006	.062	.132	.109	38.44	6120	.294	.681	.744	.012	.044	.109	4285
TAOS PUEBLO	.213	9.04	.210	1.007	.025	.172	.253	37.41	5624	.270	.879	.883	.008	.043	.232	4666
TRES PIEDRAS		9.38				.065	.187	29.96	4182	.256	.738	.710	.056	.140	.177	3551
URBAN PLACES																
RATON	.180	9.91	.170	1.104	.040	.168	.175	40.25	7820	.358	.724	.880		.038	.099	3128
LOS ALAMOS	.041	13.97	.247	1.396	.044	.098	.035	45.12	14815	.409	.721	.977		.015	.011	2222
ESPANOLA	.050	10.64	.250	1.057	.065	.149	.096	41.76	7734	.370	.650	.868		.071	.061	6237
LAS VEGAS	.126	9.71	.196	1.081	.036	.100	.078	36.15	6060	.285	.609	.789		.044	.073	3983
SANTA FE	.108	11.44	.227	1.224	.065	.096	.061	40.68	7598	.359	.653	.857		.047	.048	4795

VARIABLE NAMES:

1. PROPORTION HAVING WORKED OUT OF COUNTY BEFORE
2. AVERAGE YEARS OF EDUCATION
3. PROPORTION OF FAMILIES HAVING SMALL CHILDREN
4. PROPORTION OF FAMILIES HAVING EMPLOYMENT
5. PROPORTION OF SALES WORKERS
6. PROPORTION OF CRAFTSMEN
7. PROPORTION OF OPERATIVES (MACHINERY)
8. AVERAGE NUMBER OF WEEKS WORKED
9. AVERAGE HOUSEHOLD INCOME
10. AVERAGE DEPENDENCY RATIO
11. PROPORTION OF FAMILIES OWNING HOME
12. PROPORTION OF FAMILIES HAVING AUTOS
13. PROPORTION OF FARM LABOR LIVING IN COUNTRY
14. PROPORTION OF SPANISH-AMERICAN MANAGERS
15. PROPORTION OF SPANISH-AMERICAN OPERATIVES
16. AVERAGE OF SPANISH-AMERICAN TIMES INCOME

NOTE: BLANKS IN CELLS ABOVE INDICATE ZEROS.

Figure 5. Willingness to Commute Distributions for Four Reward Levels, Mora Census Unit



(.4314) (30.4) = 13.1

(.6714) (96.0) = 64.5

(.8201) (113.6) = 93.2

(.8980) (159) = $\frac{143.0}{313.8}$

Willingness to Commute Score

This process can be stated precisely in mathematical terms. Let

$\underline{Y} = \underline{XB} + \underline{E}$ denote the relation of the 643 x 4 matrix (643 respondents and four reward levels) to the 643 x 17 matrix of their regression variates (17 = constant + 16 variables in table 10), the 17 x 4 matrix of regression coefficients $\underline{B}$ and sampling deviations $\underline{E}$. The least squares estimates, $\hat{\underline{B}} = (\underline{X}'\underline{X})^{-1}\underline{X}'\underline{Y}$, appear in table 10. If $\underline{X}_0$, 39 x 17, contains the mean values of each of the regressor variates, given in table 11, then $\underline{M} = \underline{X}_0\hat{\underline{B}}$ determines the estimates of means given in table 7. The diagonal entries of $\frac{1}{626}\ \underline{Y}'(\underline{I} - \underline{X}(\underline{X}'\underline{X})^{-1}\underline{X}')\underline{Y}$, denoted S_k^2, estimate the related variances, one for each reward level. These estimates are calculated by the function ESTIMATE listed in figure 6.

If Φ denotes the cumulative normal distribution function, then the three-dimensional matrix τ with entries given by $\tau_{ijk} = 1 - \Phi\left(\frac{j + \frac{1}{2} - M_{ik}}{S_k}\right)$ gives the probability that a randomly selected household in the i'th census unit (i = 1, 2, ..., 39) has a head who will commute the j'th time interval (j = 0, 1, ..., 4), for the k'th reward level (k = 1, 2, 3, 4). The function named PROPORTIONS in figure 6 does this computation, and uses the supporting function named NORM for the actual calculation of probabilities.

For a specified wage level, there exists a 10 x 14 matrix $\underline{R}_w$ giving the proportion of family units in each income level for which the wage w would give reward level k. The function named REDO in figure 6 calculates this matrix. (Only the 10 lowest income levels were used because wages of $5 per hour or more were not anticipated.) If $\underline{N}$, 39 x 10, contains the income distributions for each census unit, then $\underline{N}^*_w = \underline{NP}_w$, 39 x 4, gives the related distribution across reward levels for wage w. The first line of the function named COMMUTE in figure 6 does this computation. The remainder of this function computes and prints $\sum_k n^*_{wik}\ \tau_{ijk}$, the estimated number of people in the i'th census unit who are willing to commute the j'th time interval for a wage of w.

FIGURE 6: FINAL COMPUTER FUNCTIONS USED TO PROJECT AVAILABLE COMMUTERS.

```
    ∇ ESTIMATE
[1]   STORE← 4 39 3 ⍴0
[2]   STORE[;;1]← 4 39 ⍴⍳39
[3]   STORE[;;2]←⌹XZERO+.×BHAT
[4]   STORE[;;3]←SIGMA∘.×39⍴1
    ∇


    ∇ PROPORTIONS
[1]   TAU←1-NORM LOC← 3 1 2 ⌹(-STORE[;;2]∘.-¯0.5+⍳5)÷(STORE[;;3]**2)∘.×5⍴1
    ∇


    ∇ P←NORM X;T
[1]   P←(X≥0)+(¯1*X≥0)×(÷(○2)*0.5)×(*¯0.5×X*2)×T×0.3193815+T×¯0.3565638+T×1.781478+T×¯1.821256+1.33027×T←÷1+
      0.2316419×|X
    ∇


    ∇ NSTAR←REDO WAGE
[1]   NSTAR←((MK≤1)∧MK>0)×MK←((⍳10)∘.⌊¯1+WL)-(¯1+⍳10)∘.⌈1+WL←2×WAGE- 0 0.3 0.9 1.5 ,WAGE
    ∇


    ∇ COMMUTE
[1]   NSTAR←INCOME[;⍳10]+.×REDO WAGE←⎕,0+⎕←'WHAT HOURLY WAGE RATE DO YOU WANT TO USE?'
[2]   ⍞,0+⎕←'POSITION YOUR PAPER, THEN DEPRESS RETURN.  I WILL START TYPING YOUR TABLE.'
[3]   'TABLE',(' ∧' PIC COUNT←COUNT+1),TITLE,' $∧.∧∧' PIC WAGE;TITLE1;HEADING
[4]   NAMES,('   ∧∧∧∧',48⍴'        ∧∧∧∧') PIC MASK←.×⌈+/TAU×⌹NSTAR∘.×5⍴1
[5]   →1×⍳(,⍞)[1]='Y',0+⎕←(9⍴RTN),'WANT TO RUN WITH ANOTHER WAGE RATE?'
    ∇
```